

NOAA Data Report ERL AOML-13

CURRENT VELOCITY AND HYDROGRAPHIC OBSERVATIONS IN THE SOUTHWESTERN NORTH ATLANTIC OCEAN: SUBTROPICAL ATLANTIC CLIMATE STUDIES (STACS), 1988

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## I. INTRODUCTION

The primary objectives of the STACS program are to increase our understanding of the dynamics of the North Atlantic circulation and the role of ocean circulation in global climate, to develop the capability to monitor the climatically important processes, and to provide data needed in the development of the coupled ocean-atmosphere general circulation models to be used for global climate prediction. In particular, the mechanisms by which the ocean transports heat to balance the net radiation deficit at northerly latitudes are being studied.

The initial objectives of STACS (Molinari et al., 1985) were directed at the Florida Current, a flow which makes significant contribution to heat flux. After an intensive two-year observing program, we have the capability to monitor Florida Current transport without extensive ship-board observations. Data collected during this period are listed in Williams et al. (1983), Leaman and Vertes (1983), Vertes and Leaman (1984), and Ratnaswamy et al. (1985). STACS efforts during 1984-86 were directed toward studying the relationship of western boundary currents along the Antillean Archipelago and in the Caribbean Sea to the dynamics of the North Atlantic subtropical gyre and on meridional heat flux, while continuing the monitoring effort in the Florida Current at 27°N. Data collected during these cruises are given in Wilburn et al. (1987a,b). STACS efforts during 1987 continued the observational studies of western boundary currents, extending the study area southward to northern Brazil (4°N) (Figure 1) in order to examine the contribution of cross-equatorial boundary currents to the North Atlantic mass and heat fluxes (Wilburn et al., 1988).

During the period covered by this report, 1988, STACS observational efforts were concentrated on the region between Barbados (13°N) and northern Brazil (4°N), with the emphasis on examining the mean and variability of cross-equatorial fluxes of mass and heat within the western boundary current systems. In addition, the monitoring effort along the transect east of Abaco, the Bahamas (26.5°N) continued. Figures 2-4 show station locations for the March, July, and September 1988 cruises respectively. XBT data were generally collected along the entire cruise track, with CTD-0, and Pegasus stations taken where indicated.

## II. DATA COLLECTION AND ANALYSIS

Data from STACS cruises conducted on the NOAA Ships WHITING and MT. MITCHELL during three cruises—March, July, and September 1988—are contained in this report. Table 1 shows the type of data collected on each cruise. Techniques used to reduce the Pegasus, CTD, and XBT data to final form are described below.

### A. Pegasus Current Profiler

The Pegasus instrument is an acoustically-tracked, free-falling profiler of horizontal current components (Spain et al., 1981). A schematic of the Pegasus system is shown in Figure 5. The Pegasus instrument used by AOML consists of a hollow cylindrical metal tube with the electronics package sealed within. A flotation collar attached to the exterior of the cylinder provides the instrument buoyancy. Pegasus houses a transducer/receiver, a thermistor and a pressure sensor. When the Pegasus is in the water, its transducer interrogates two fixed transponders on the ocean bottom at a

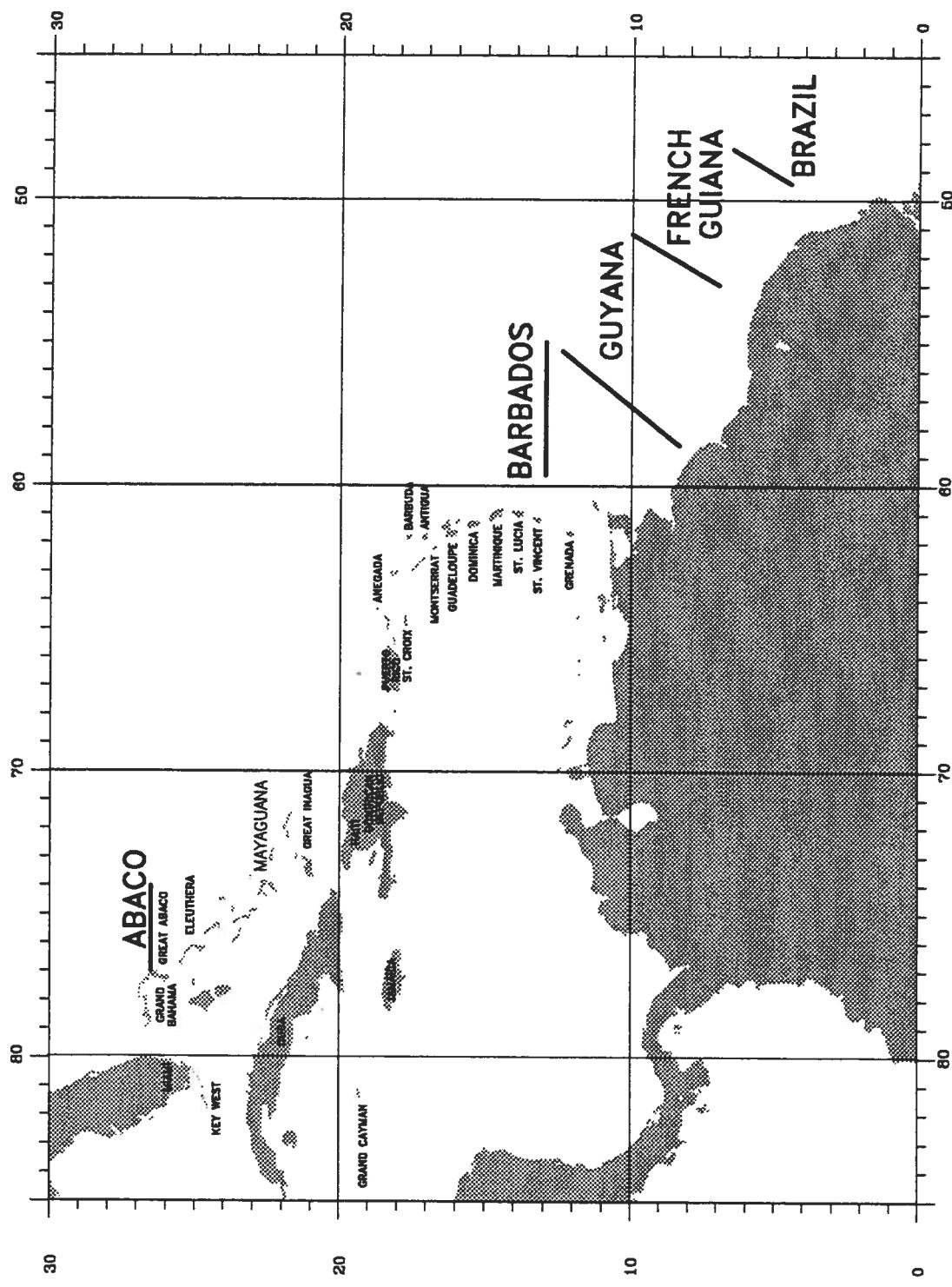
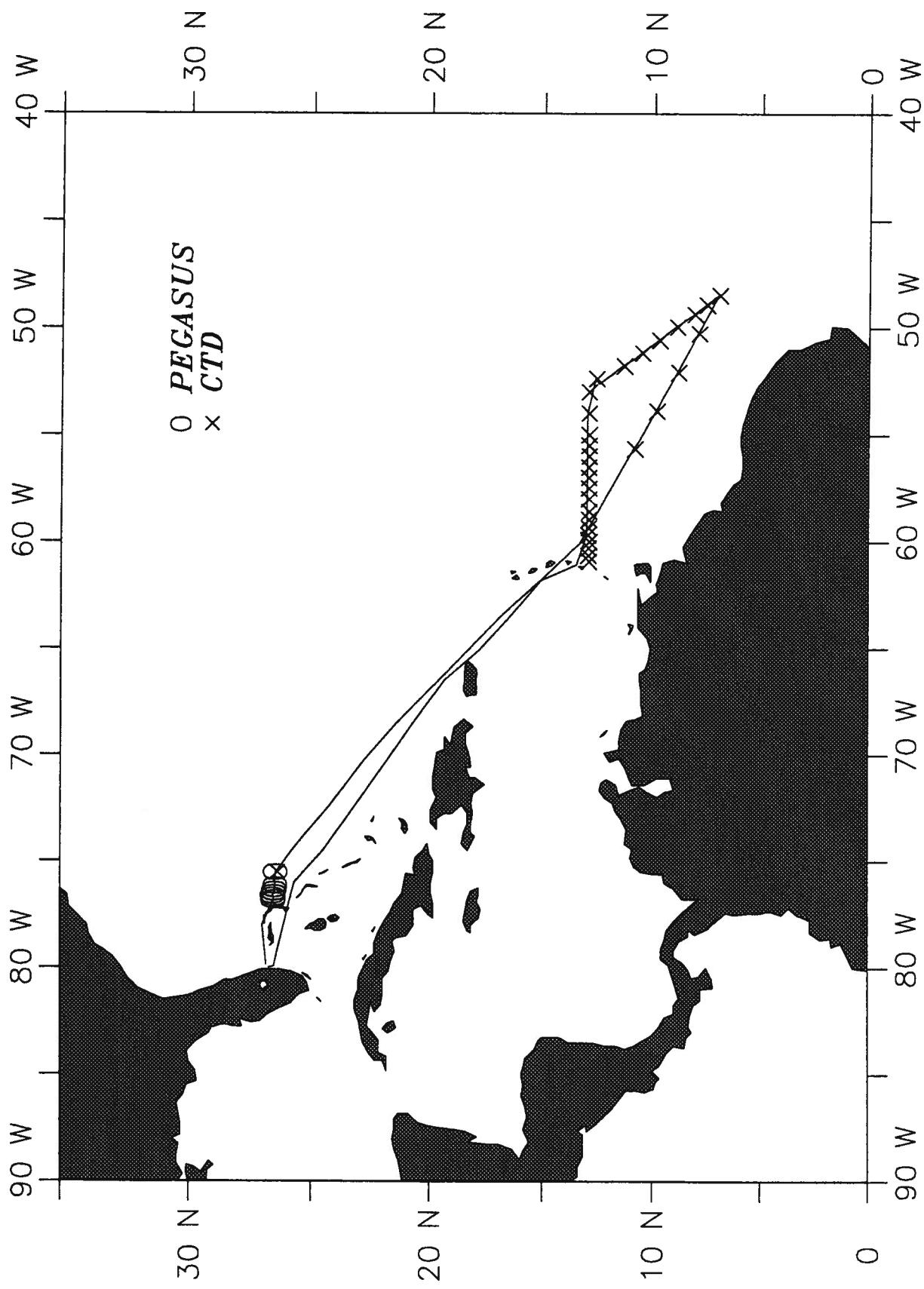
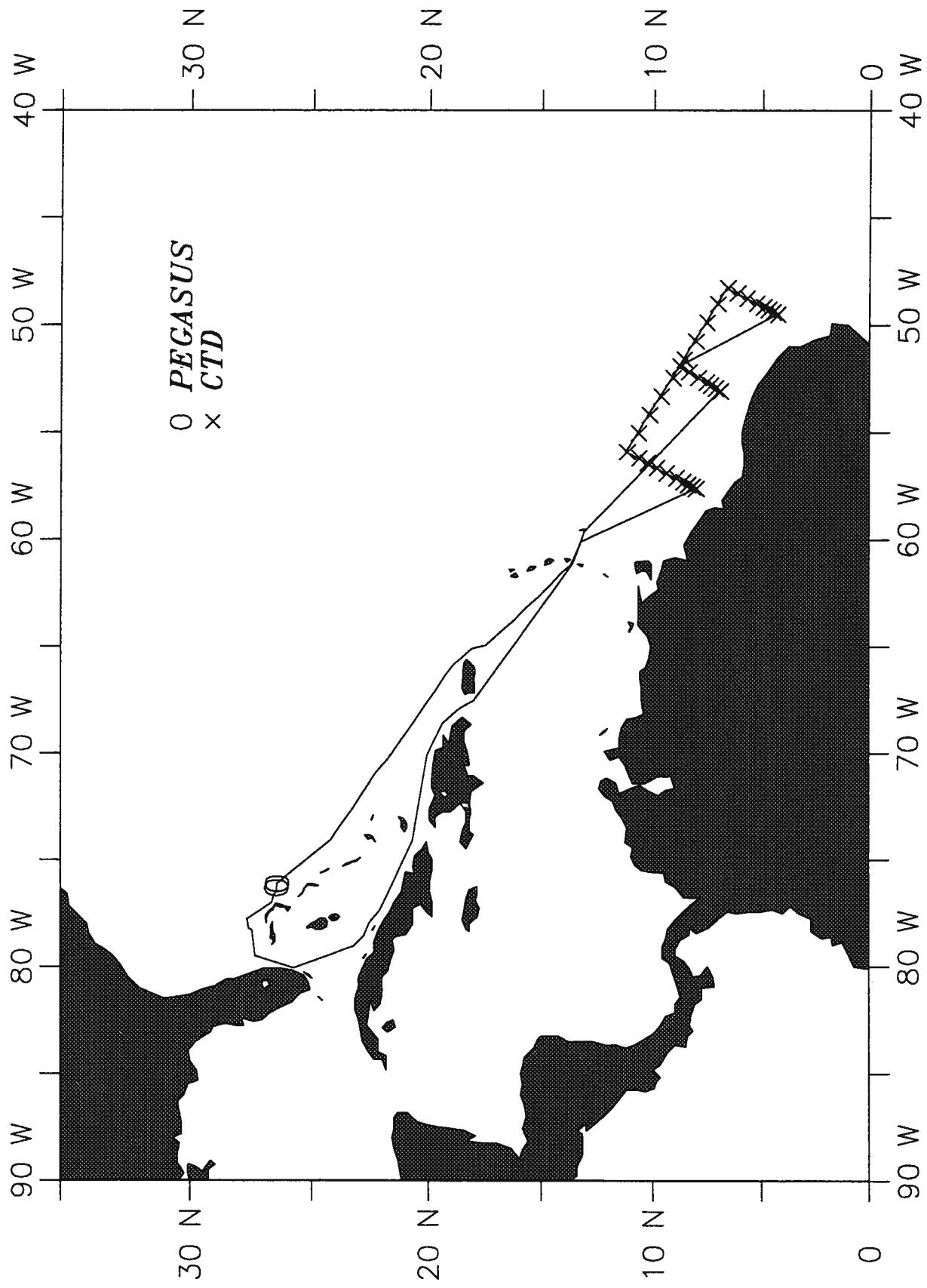


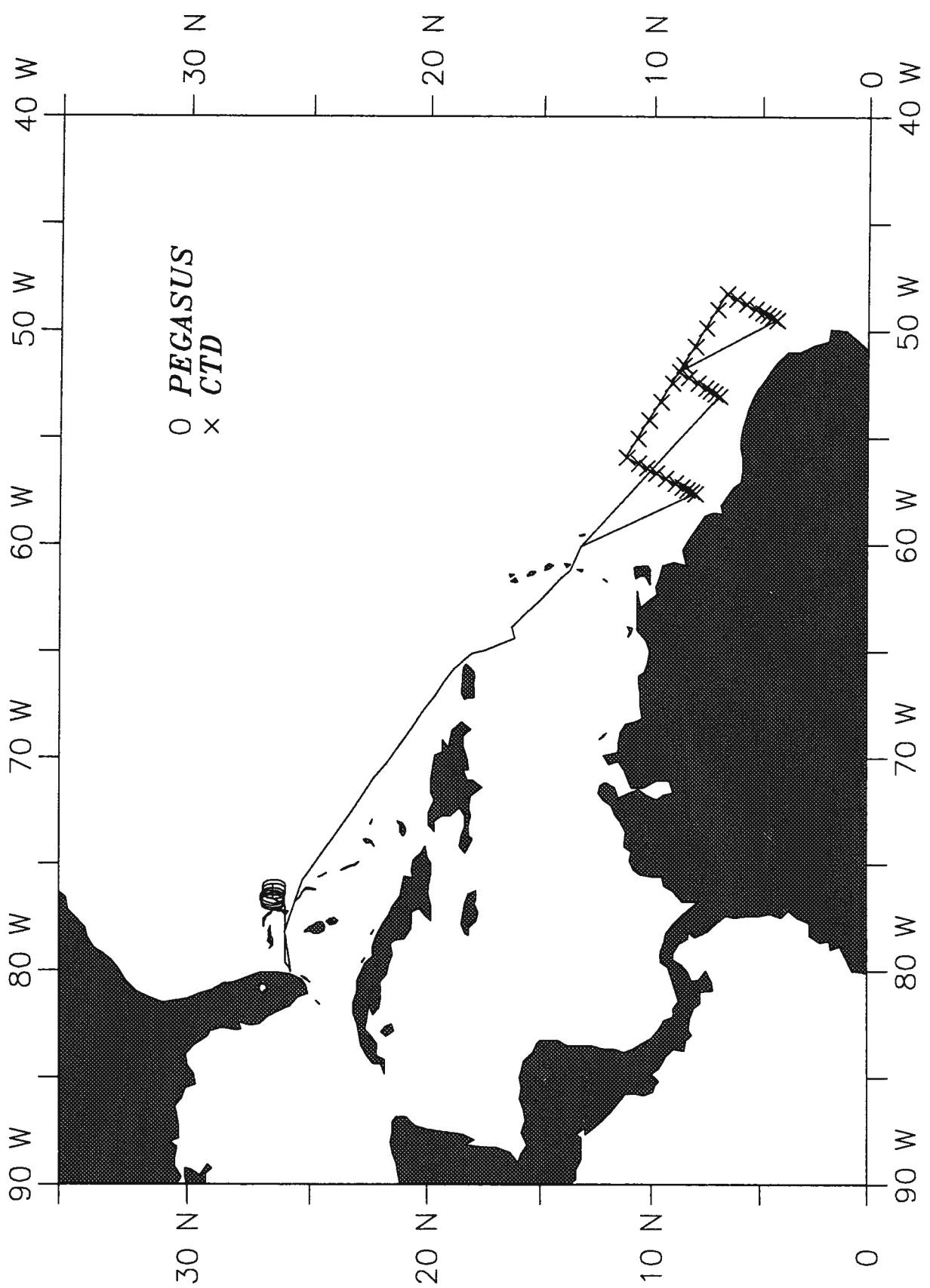
Figure 1: Map of the STACS study area.



**FIGURE 2.** STACS Cruise Track for March 1988 showing CTD & Pegasus sampling stations.



**FIGURE 3.** STACS Cruise Track for June 1988 showing CTD & Pegasus sampling stations.



**FIGURE 4.** STACS Cruise Track for SEPTEMBER 1988 showing CTD & Pegasus sampling stations.

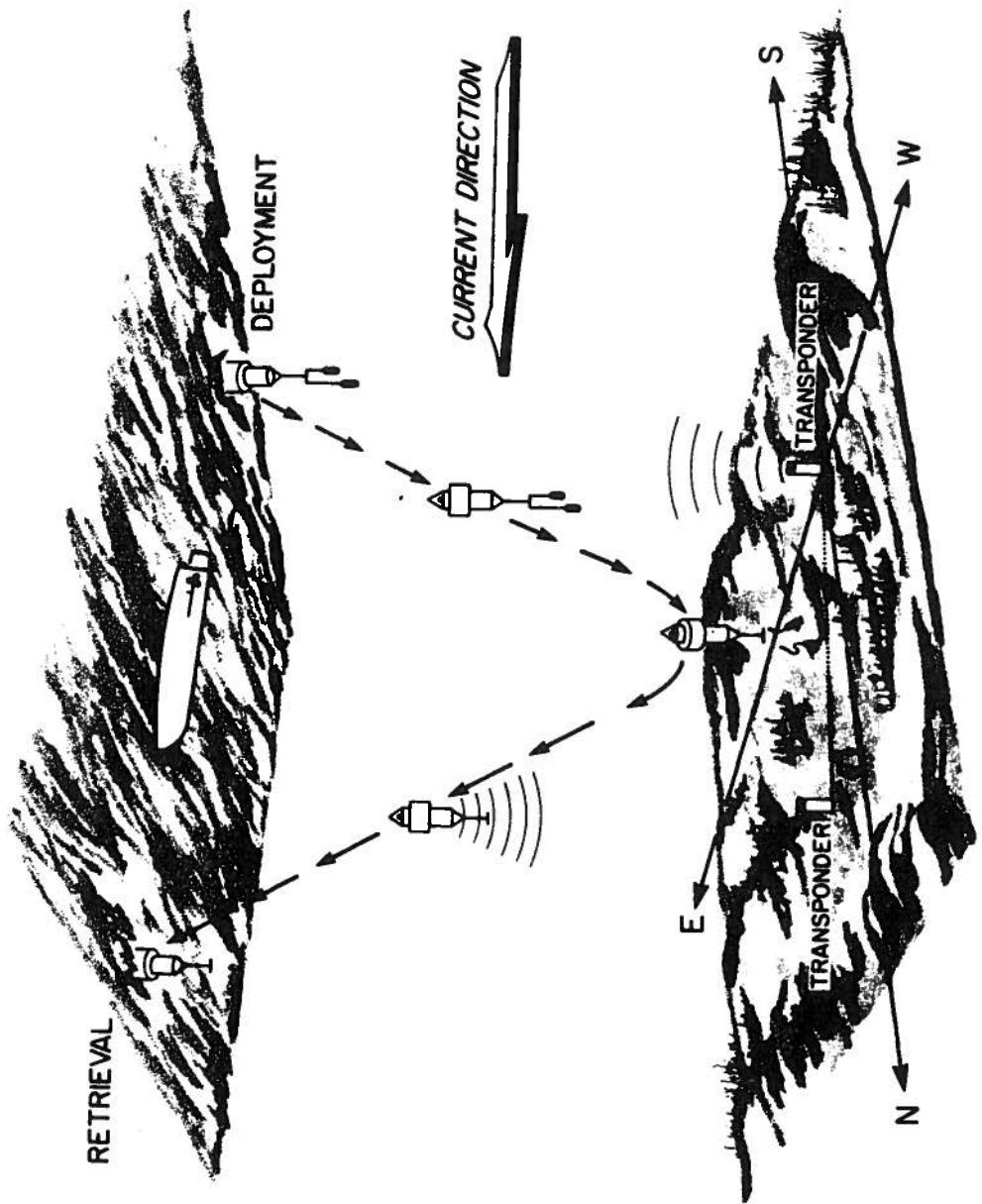


Figure 5: Schematic of the Pegasus current profiler.

Table 1. Types of Data Collected by Cruise.

Cruise	Vessel	Dates	Pegasus	CTD	XBT
February 1988 (WH-88-01-STACS)	WHITING	2/16-3/27/88	6	30	61
June 1988 (WH-88-02-STACS)	WHITING	6/16-7/25/88	2	33	43
September 1988 (MI-88-01-STACS)	MT. MITCHELL	9/12-10/9/88	6	29	149

frequency of 10 KHz at an interval of eight or sixteen seconds. Each transponder responds at a different frequency. The Pegasus internally records the acoustic travel times from the transponders, along with temperature and pressure. Transponder frequency pairs are alternated between stations in order to avoid interference from adjacent stations.

The instrument is weighted at the beginning of the drop and falls at a rate between 20-50 cm/sec. This rate may be adjusted by adding or removing weights. External weights are released by a bottom trip mechanism when the weights touch the ocean floor or by a pressure release when the Pegasus reaches a predetermined depth. The instrument ascends at approximately the same rate as it descends.

Each Pegasus station is defined by a unique geometry (see Table 2). A mean sound velocity profile for each station is used to convert the acoustic travel times from the transponders to the instrument into ranges in meters. The baseline becomes the base of a triangle which is projected onto the bottom. The X and Y coordinates of the instrument at each pressure can then be determined.

Following a Pegasus cast the contents of the instrument's solid state memory are transferred to a Hewlett Packard 85 computer for conversion to decimal values and storage on flexible diskettes. The conversion of raw data to a velocity profile is done on an HP-86 in three steps: editing, calibration and velocity computations. Following is a brief description of each step.

### 1. Editing

Two files are created for each Pegasus cast: an ASCII character header file on magnetic tape containing cast information and a multi-record data file on magnetic disk. Each record contains decimal values of the original Pegasus memory address, corresponding pressure and temperature sensor output counts and two travel times significant to  $10^{-4}$  second. HP-86 BASIC programs allow graphic display and printed listings of the data for preliminary evaluation of data quality.

Errors can be introduced into the raw data due to instrument hardware errors and into the travel times by acoustic propagation. irregularities such as the detection of reflected instead of direct path signals. Erroneous points are hand edited from the record and replaced by points estimated by a low order polynomial fit.

### 2. Calibration

Prior to each research cruise the Pegasus pressure sensor is calibrated to produce second order polynomial fits of pressure counts versus pressure in decibars (db). Standard deviations from the fits over the working range of the sensors are generally on the order of 1 db. After the raw data has been edited the pressure counts are converted to decibars. Pressure is further smoothed with a five point running mean. Cast limits (surface/bottom/surface) are recorded in the header file and the data are split into downcast and upcast files containing two travel times and pressure (db).

Table 2. Summary of Pegasus Station Geometry off Abaco Island.

Station	Transponder Parameters				Baseline Length (m)
	Latitude (N)	Longitude (W)	Frequency (KHz)	Depth (m)	
15	26°30.83'	76°19.01'	12.0	4810	4296
	26°31.74'	76°21.55'	13.0		
16	26°32.86'	76°29.98'	13.0	4825	4410
	26°32.86'	76°32.65'	11.5		
17	26°35.48'	76°39.30'	12.5	4050	3937
	26°33.72'	76°39.31	12.0		
18	26°32.56'	76°45.29'	13.0	3600	3570
	26°30.53'	76°44.88'	11.5		
19	26°33.07'	76°51.16'	12.0	800	1311
	26°32.22'	76°50.92'	11.5		
34	26°29.90'	76°07.22'	12.5	4810	4197
	26°29.71'	76°09.61'	12.0		
35	26°29.31'	75°32.34'	12.0	4610	4038
	26°29.44'	75°29.94'	12.5		
36	26°30.20'	74°32.97'	12.0	4460	1665
	26°30.12'	74°30.31'	12.5		

### 3. Velocity Calculation

Given the transponder depths, baseline length, pressure and the travel times, the Pegasus position can be determined. Each station has an associated sound velocity profile used to calculate harmonic mean velocity and thus convert acoustic travel times to distance for input into the position equations. The resulting profiles of X and Y position (in unrotated baseline coordinates) versus depth are smoothed with a seven point convolution. The resulting U and V velocity components are then rotated into a true geographic coordinate system. Each cast produces two profiles: one represents the downcast portion and the other the upcast. Only one profile from each cast is chosen based on a subjective comparison of the up and down profiles and these data for each cruise are presented by increasing cast numbers in Appendix A. The positions represent deployment locations rather than the transponder positions listed in Table 1.

## B. CTD Data

### 1. System Description

The Neil Brown Instrument Mark III CTD system used in STACS includes pressure, temperature, salinity and oxygen sensors. The oxygen data will be described in a future report.

The instrument scans at a rate of 30 scans per second. The descent rate is approximately 30 meters per minute to a depth of 200 meters then increases to 60 meters per minute for the remainder of the cast. CTD values are averaged in one decibar increments. Appendix B contains graphic representations of CTD profiles arranged by cruise and cast number. CTD values are listed at selected depths.

### 2. Calibration

Laboratory calibrations are used for the CTD pressure and temperature sensors. Reversing thermometer data are in agreement with the CTD temperatures to within  $\pm .01^{\circ}\text{C}$ . CTD pressures are assumed to be accurate to within  $\pm 6.5$  db. Bottle salinities are collected using a rosette sampler lowered with the CTD, with the final values determined using a Guildline Autosal unit. The bottle salinities are used for calibration of the raw CTD data using the methodology described below.

- a. The bottle salinities are edited for obvious bad values, i.e., outliers, by examination of the residual differences between bottle and CTD salinities over the entire water column and by means of graphical comparisons with previous regional STACS and TTO (Williams, 1986 a&b) temperature/salinity relationships in the deep water.
- b. The uncalibrated CTD salinity vs. pressure profiles are examined for conductivity sensor changes and/or drift by examination of the time history of the residual differences between the edited bottle values and the CTD salinities, and divided into calibration subgroups if necessary. An iterative least squares regression is run on the residual (bottle salinity minus CTD salinity) vs. pressure data sets for each subgroup, and linear or polynomial fits are obtained over appropriate portions of the water column.

- c. The uncalibrated CTD salinity profiles are corrected using the results of the regressions, and the TS correlation is again compared with the historical data set as a final quality check. The calibrated CTD salinity and temperature data are despiked, and a final data set subsampled to 2 db spacing is produced.

Discussions of the bottle salinity quality and CTD performance for the individual cruises, and tabulations of the respective calibration corrections, follow.

March 1988:

Due to limitations associated with the winch system onboard the R/V WHITING, most of the CTD casts taken during the March 1988 cruise were limited to 3000 m depth. The bottle salinity data were also not up to satisfactory quality standards during this cruise due to problems with deck and laboratory facilities and as a result the first 7 out of 30 casts did not produce usable bottle salinities. Casts 8 through 30 had usable salinities, but with fairly high scatter, requiring 20% of the values to be discarded during the iterative least-squares analysis of the bottle-CTD residual values.

After discarding these values, the remaining 80% of the data showed a consistent correction (where  $dS$  is added to the uncalibrated CTD salinity values) of  $dS = -.001 \pm .003$  ppt, with no significant depth dependence, as shown in Figure 6a. (In other words, the raw CTD data were nearly correct without any calibration.) A  $-.001$  ppt correction was applied uniformly to casts 1 through 30, and comparisons with the historical regional TS correlation produced satisfactory results.

July 1988:

The maximum depth of the CTD casts taken during the July 1988 cruise was 2600 m, due again to limitations associated with the winch system. The bottle salinity data were better during July 1988 than March 1988, with 92 to 96% of the values used for the least squares fit to the CTD values over the first 20 of the total of 33 CTD casts. However, the CTD performance was not as good as during the March 1988 cruise, exhibiting a  $-.005$  ppt linear drift over time from the tenth cast to the end of the cruise. In addition, the first 20 casts showed a depth dependence in the upper 500 to 1000 m which required the use of a linear fit in the upper portion of the water column, and a constant correction in the deeper water. The changeover depth (1000 to 1500 m) was selected such that the two calibration fits agreed to within .001 ppt. An example of the analysis is shown in Figure 6b. The various subgroup corrections are tabulated below, with the percentage of the bottle values used in the analysis. Comparisons with the historical regional TS correlation in the deep water confirmed that the final calibrated data were satisfactory despite the CTD drift problem.

Casts	Calibration Correction
1-10	< 1000 m: $dS = .003$ ppt + $4.36e^{-6} * \text{pressure}$ > 1000 m: $dS = .007 \pm .002$ ppt (92%)
11-15	< 1500 m: $dS = .002$ ppt + $2.16e^{-6} * \text{pressure}$ > 1500 m: $dS = .005 \pm .002$ ppt (94%)

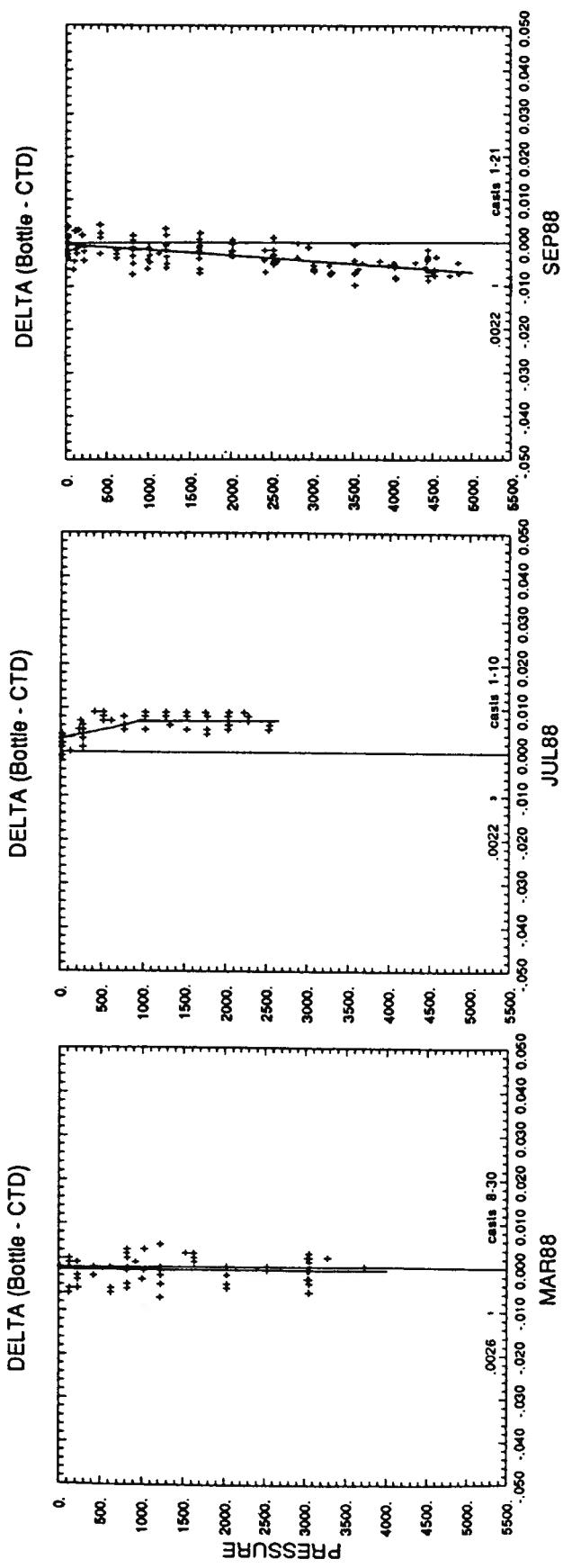


Figure 6. Calibration regression analysis for the March (4a), July (4b), and September (4c) 1988 cruises. Bottle salinity minus uncalibrated CTD salinity values in ppt are shown as +'s vs. pressure in db, and the various linear fits which were used for the calibration are shown as the solid curves. Standard deviation values are indicated at the lower left of each panel.

<u>Casts</u>	<u>Calibration Correction</u>
16-20	< 1000 m: $dS = .002 \text{ ppt} + 2.16e^{-6} * \text{pressure}$ > 1000 m: $dS = .004 \pm .002 \text{ ppt}$ (96%)
21-26	> 0 m: $dS = .003 \pm .003 \text{ ppt}$ (80%)
27-33	> 0 m: $dS = .002 \pm .002 \text{ ppt}$ (65%)

September 1988:

The bottle salinity data quality and CTD performance were both improved during most of this cruise over the two previous 1988 cruises, with one simple linear calibration fit used for the first 21 out of 29 casts. During the last 8 casts of the cruise the Autosal malfunctioned, and the bottle salinity data were not usable. However, these 8 casts were taken east of Abaco, the Bahamas, and extended to the bottom (> 5000 m) where the historical TS relationship is very predictable. Therefore, the historical values were used in the deep water, with the same linear slope as casts 1-21 applied. The difference between the two calibrations is only -.003 ppt, but this is significant in the deep water. The calibration fits are tabulated below, with the percentage of the bottle values used in the computation, and the analysis from casts 1-21 is shown in Figure 6c. Comparison with the historical regional TS correlation confirmed that the calibration was satisfactory.

<u>Casts</u>	<u>Calibration Correction</u>
1-21	$dS = -.000 \text{ ppt} - 1.35e^{-6} * \text{pressure} \pm .002 \text{ ppt}$ (94%)
22-29	$dS = -.003 \text{ ppt} - 1.35e^{-6} * \text{pressure}$ (historical TS)

C. XBT Data

T-4, T-5, T-6 and T-7 expendable bathythermograph (XBT) probes were used during all of the cruises covered in this data report. Appendix C presents XBT data by cruises and cast number.

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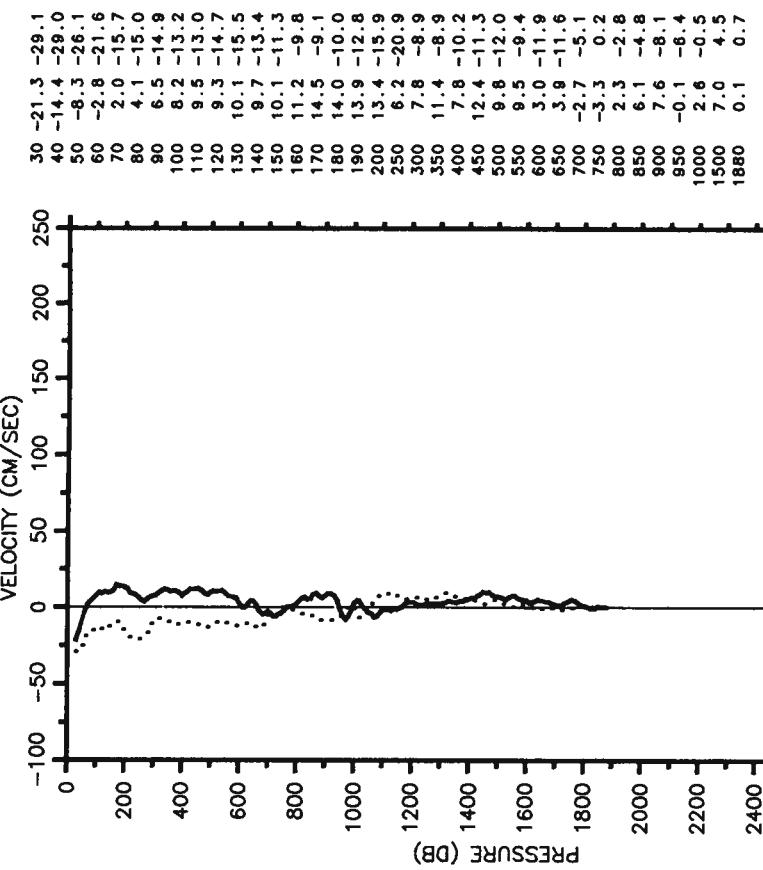
#### IV. ACKNOWLEDGMENTS

The extensive efforts of the officers and crew of the NOAA Ships WHITING and MT. MITCHELL are gratefully acknowledged. Contributions by scientific and technical personnel Bob Molinari, Doug Anderson, Bob Roddy, Warren Krug, and Dave Bitterman of NOAA/AOML and Leslie Rosenfeld of the University of Miami (RSMAS) are greatly appreciated.

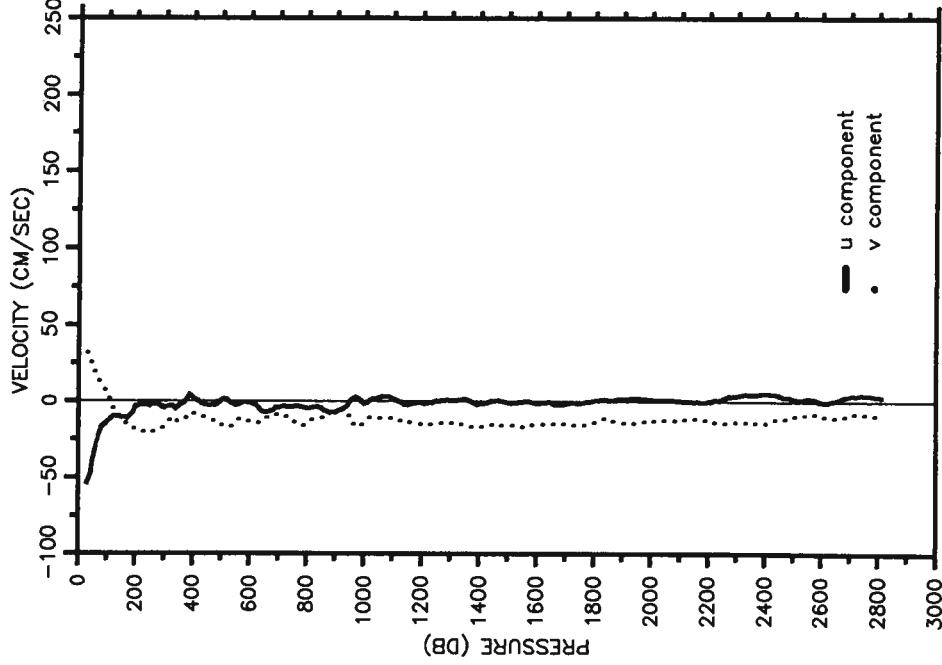
#### **APPENDIX A: PEGASUS DATA**

Casts are presented by cruise and increasing cast number. The cruise number and vessel, Pegasus cast and station number, Julian day and time, and position are shown at the top of each plot. "U" represents the east component of velocity. "V" represents the north component. Casts where there are no data values given for the U and V components indicate that the transponders signals were not being received by the Pegasus instrument at the given depth.

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 R/V WHITING JDAY 81 TIME 0417Z  
 Latitude 26.453 N Longitude 075.534 W  
 Prs U V

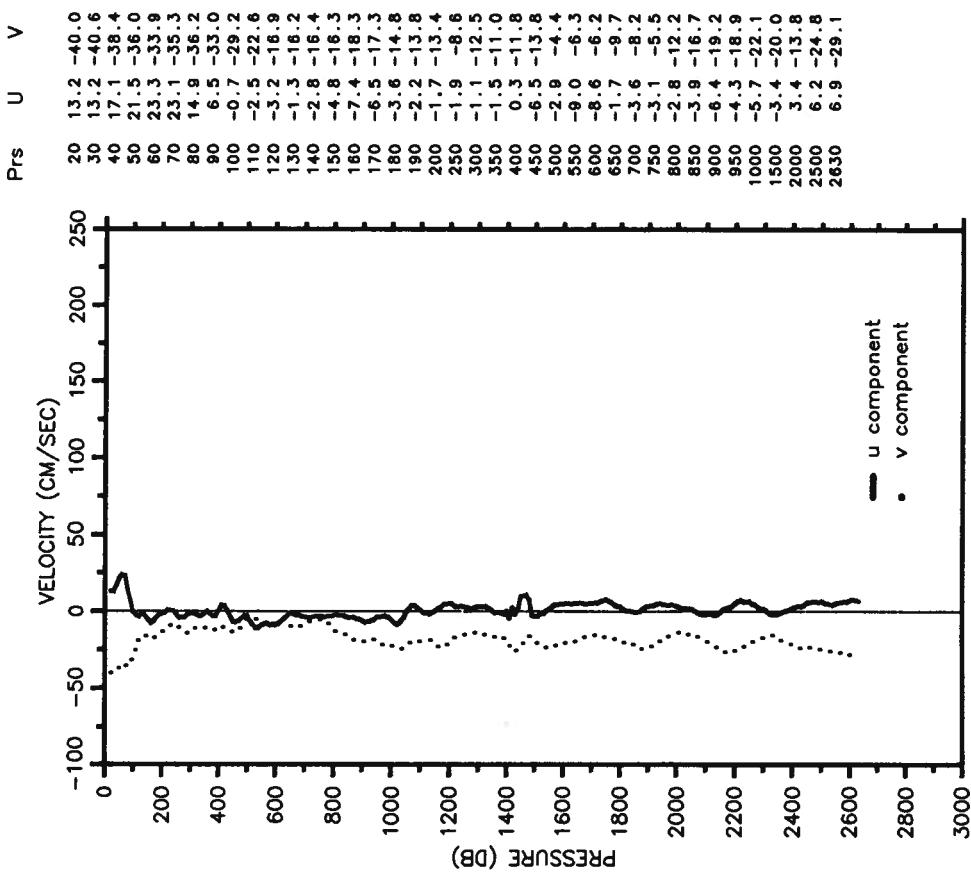


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 R/V WHITING JDAY 81 TIME 1723Z  
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 Prs U V

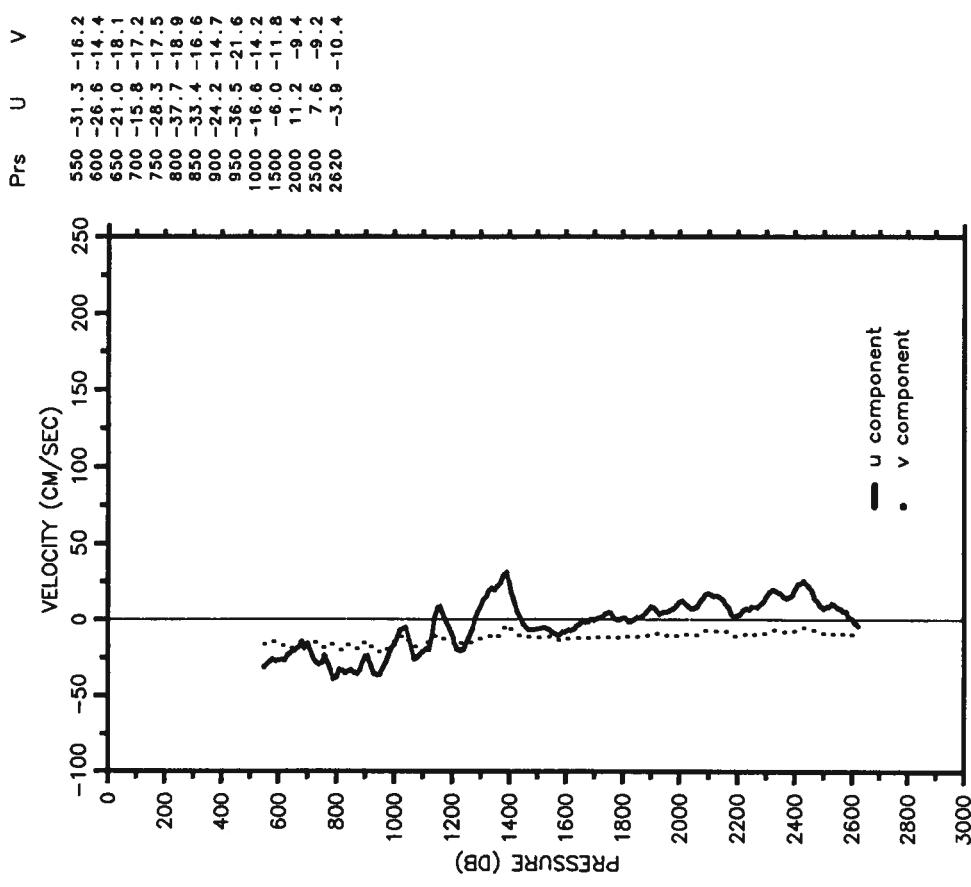


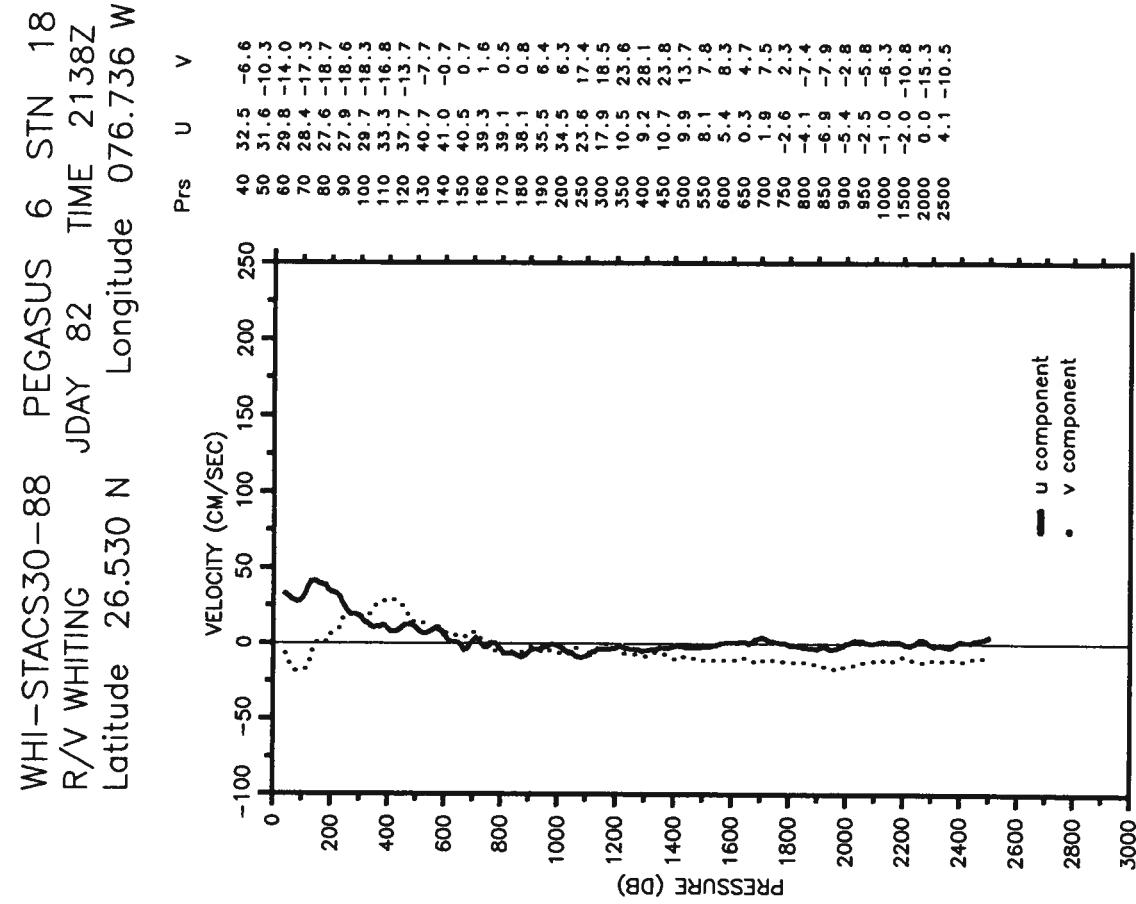
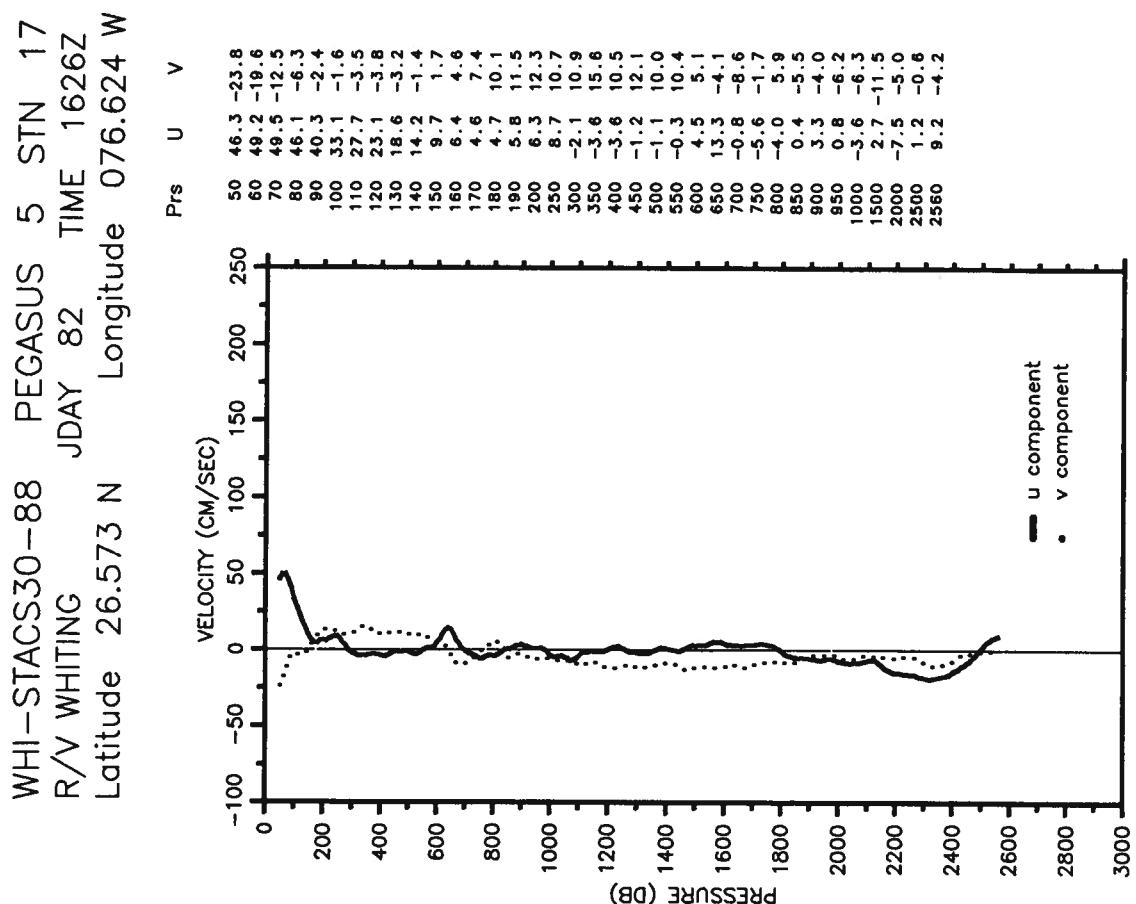
— u component  
• v component

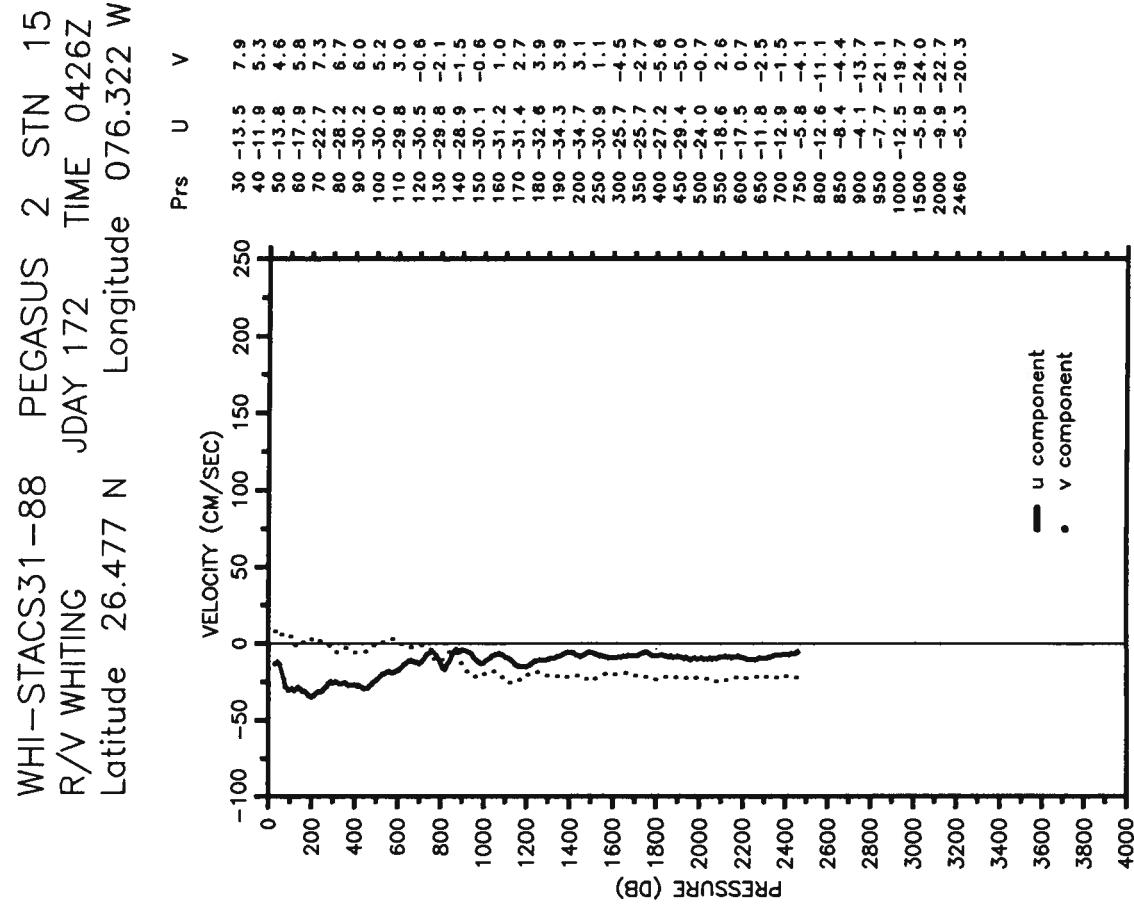
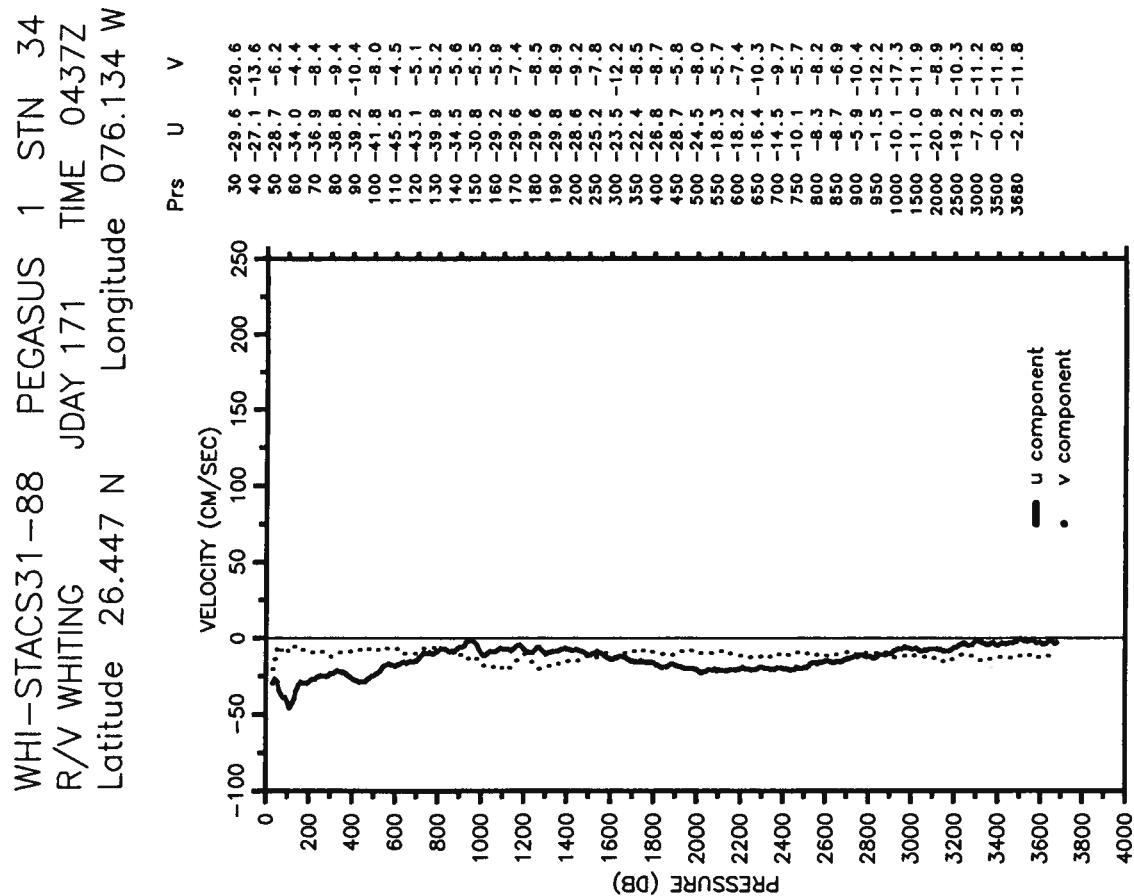
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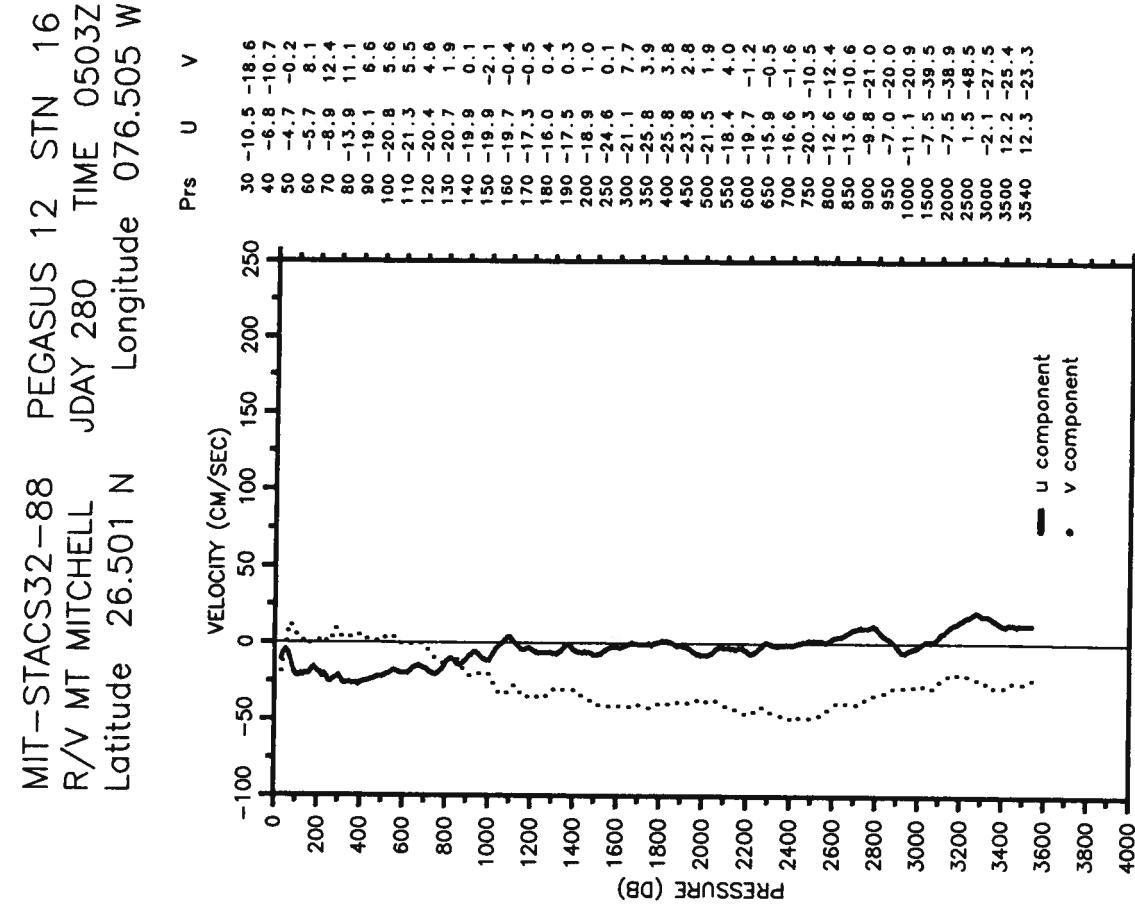
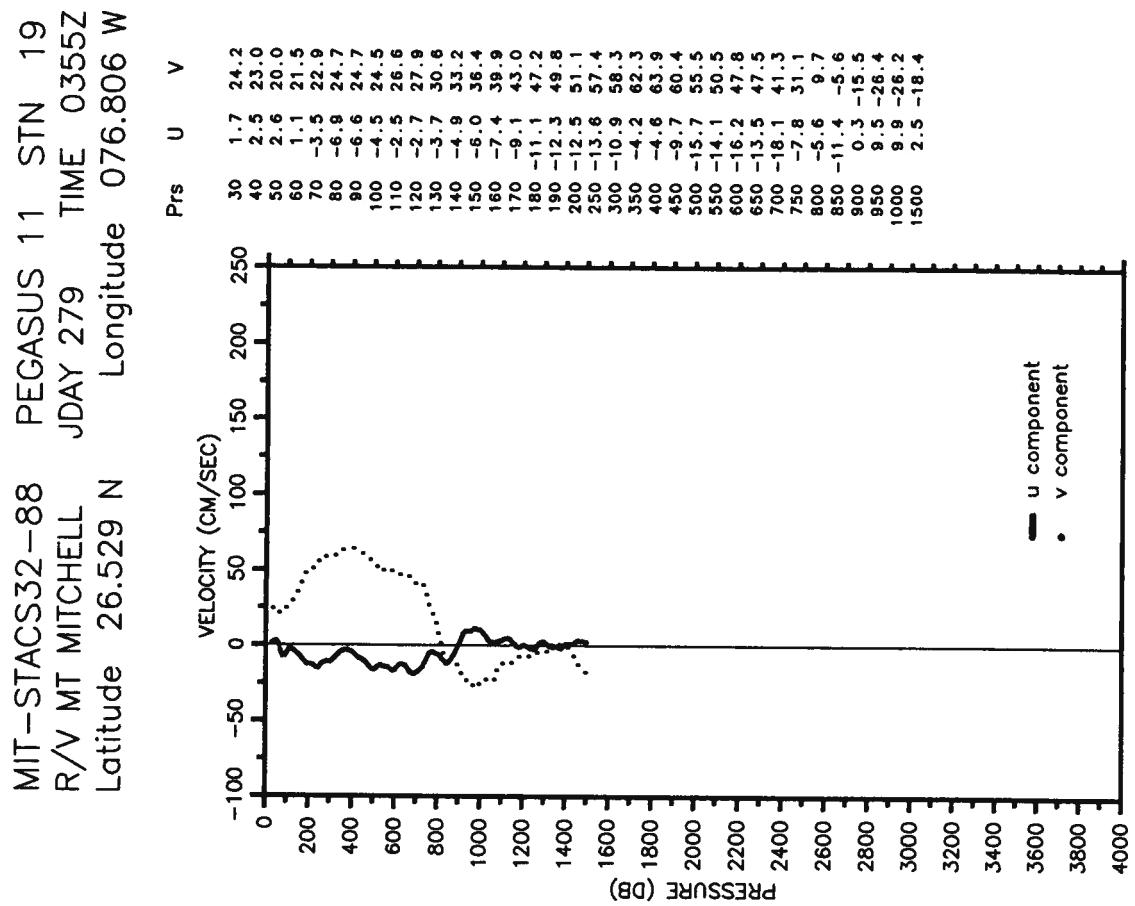


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 Latitude 26.532 N      Longitude 076.492 W



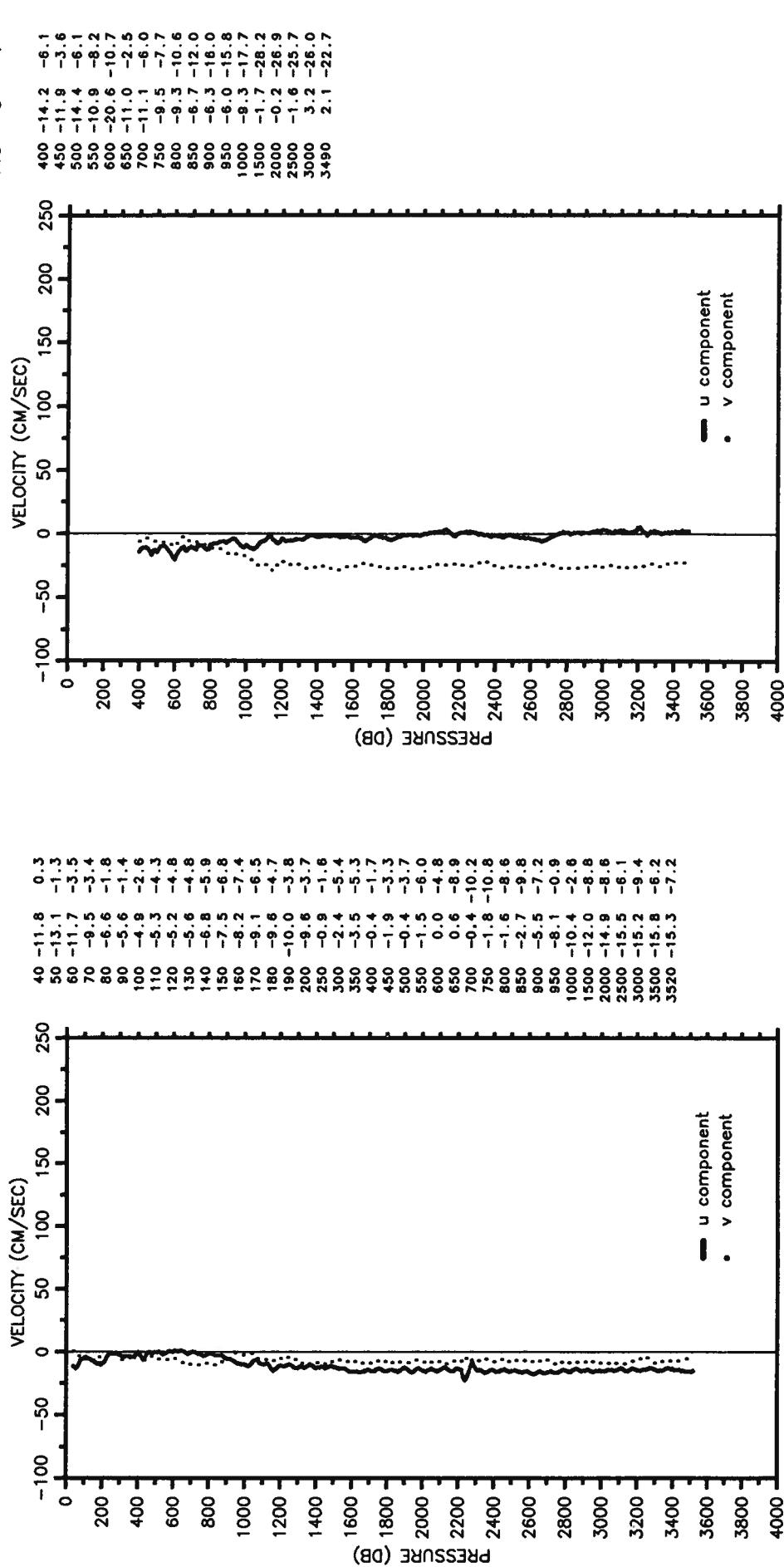


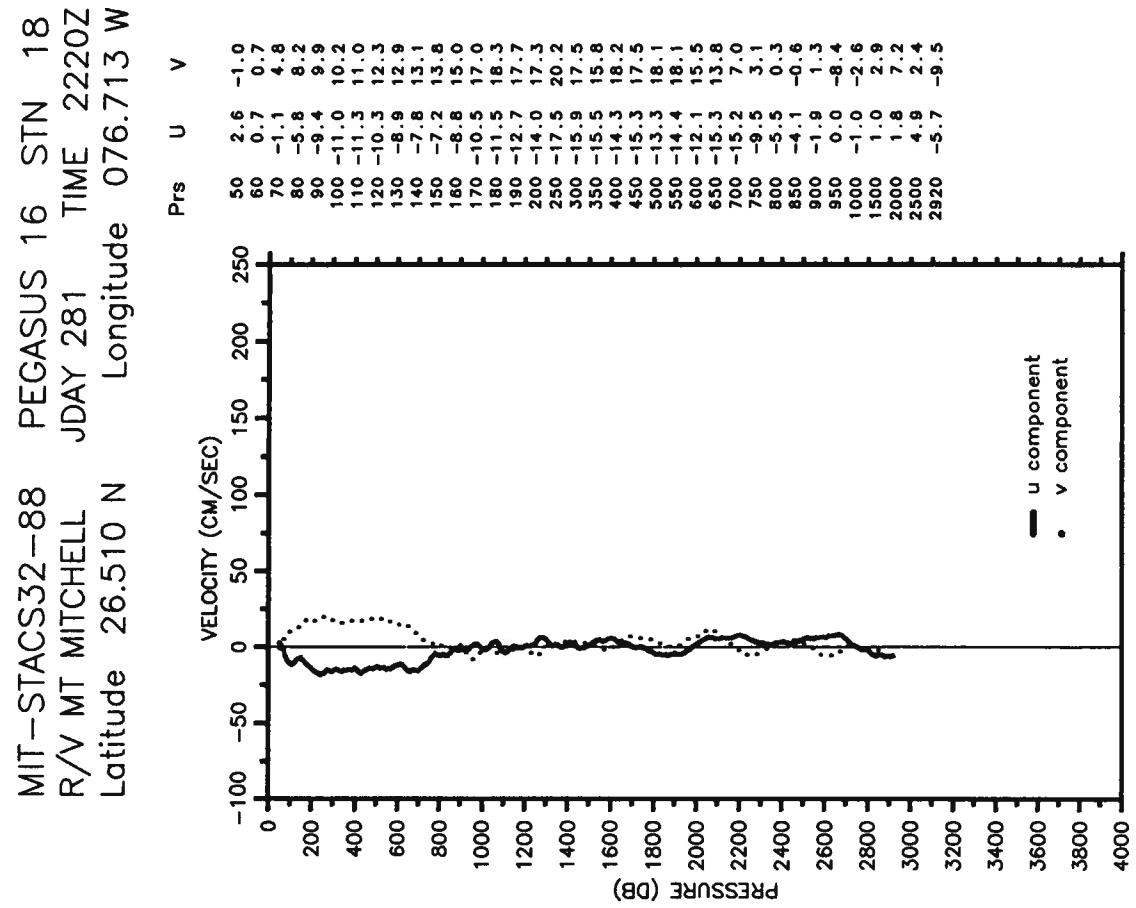
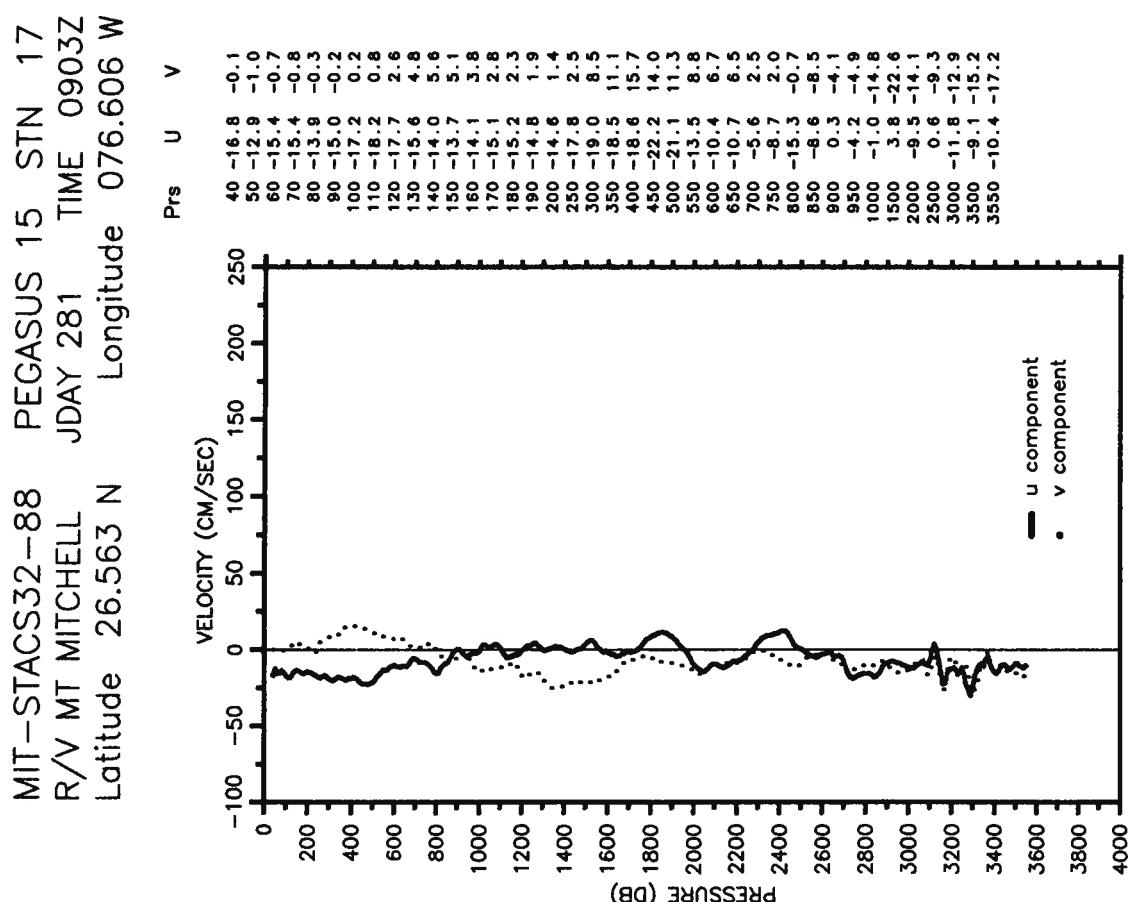




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 R/V MT MITCHELL      JDAY 280 TIME 1947Z  
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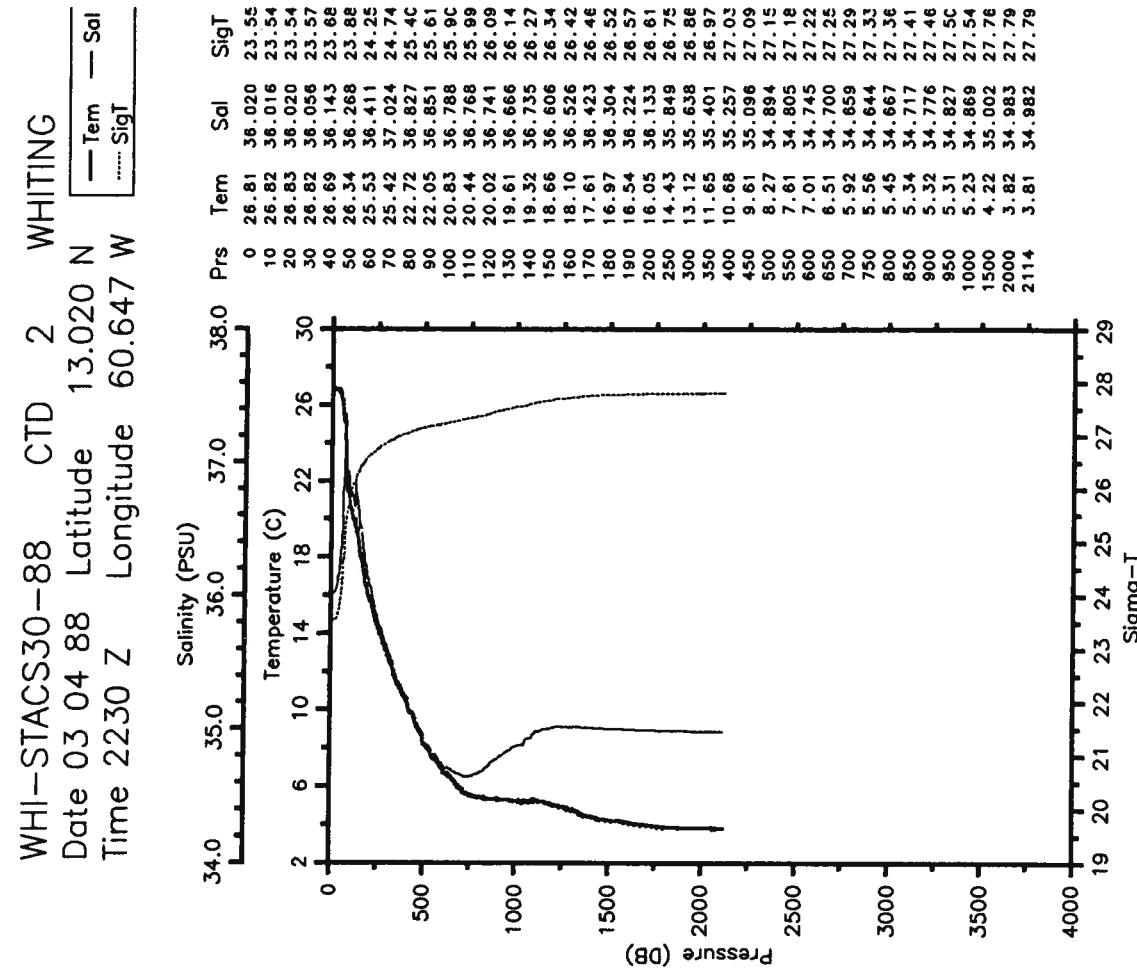
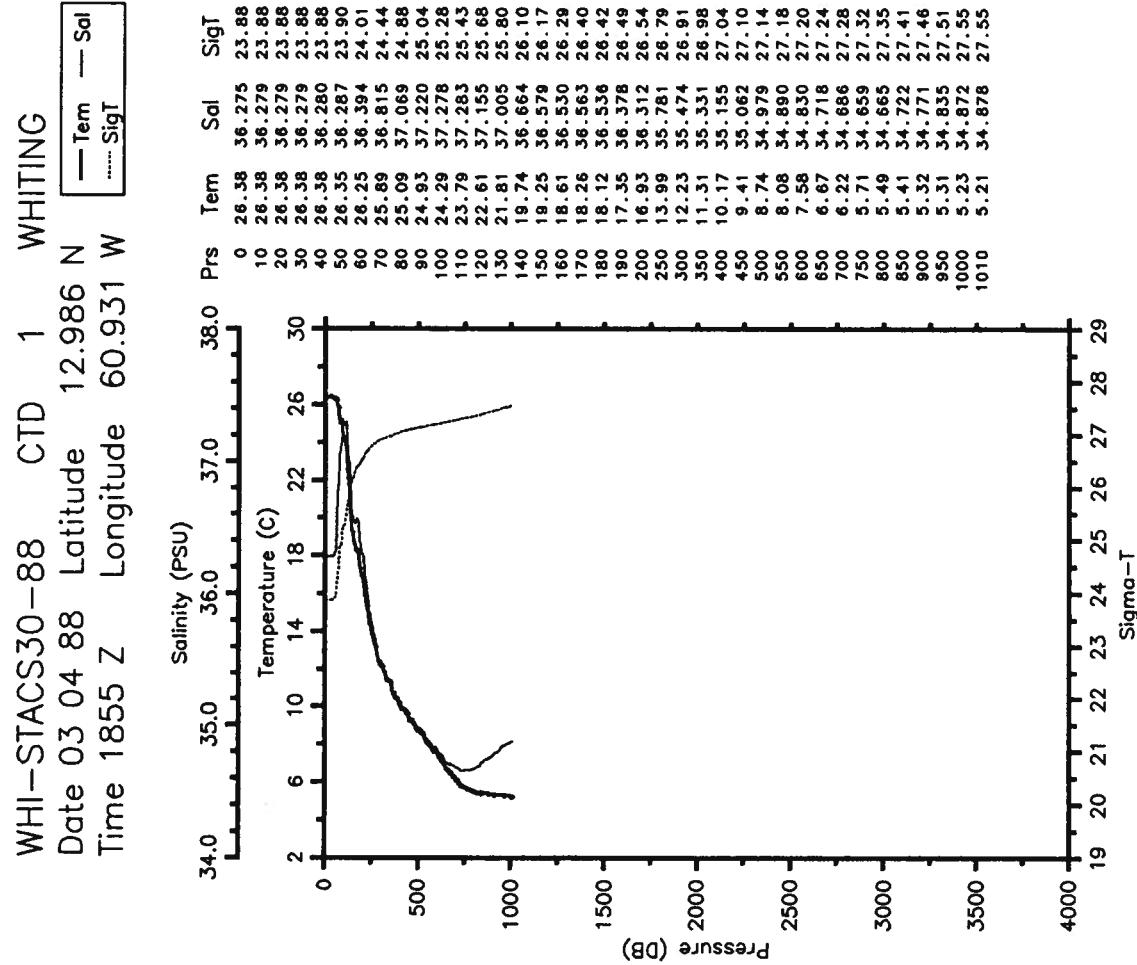
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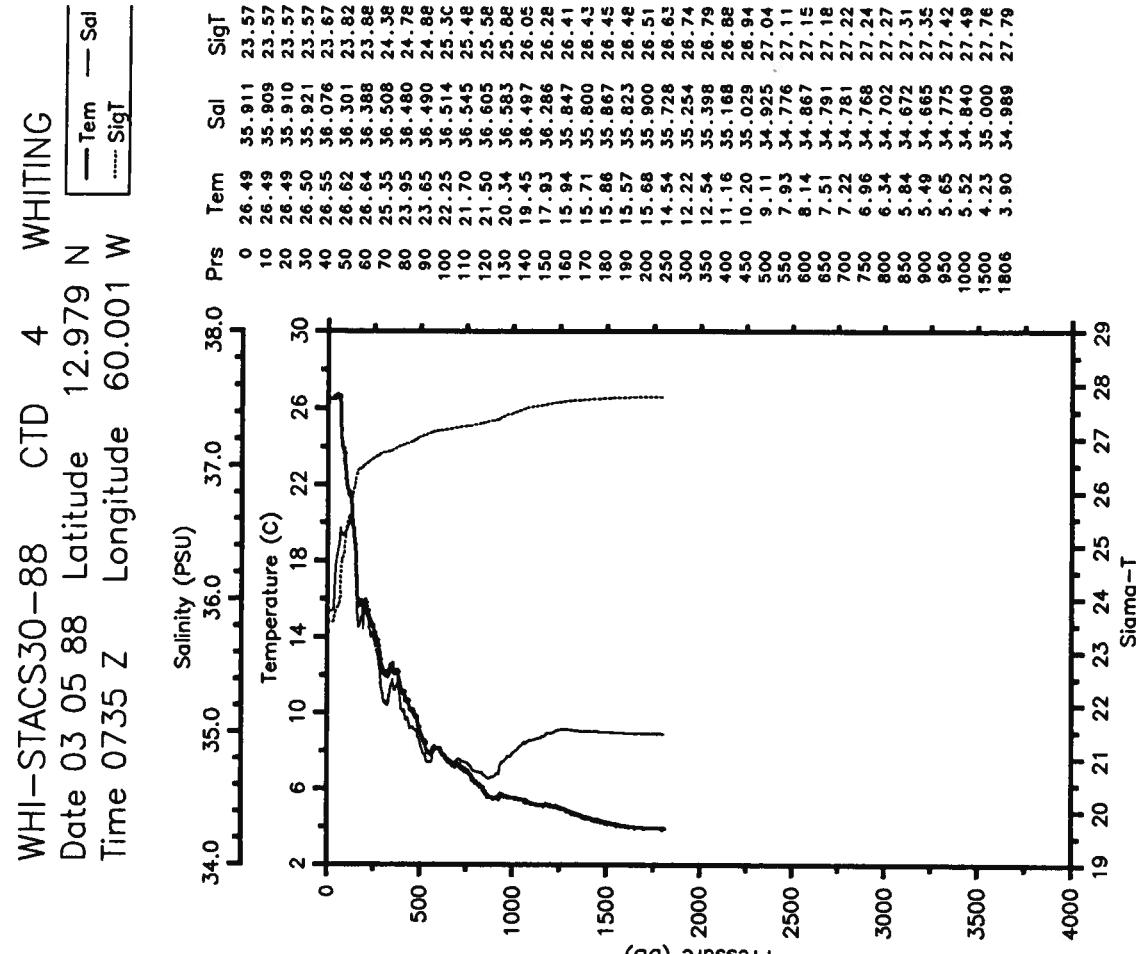
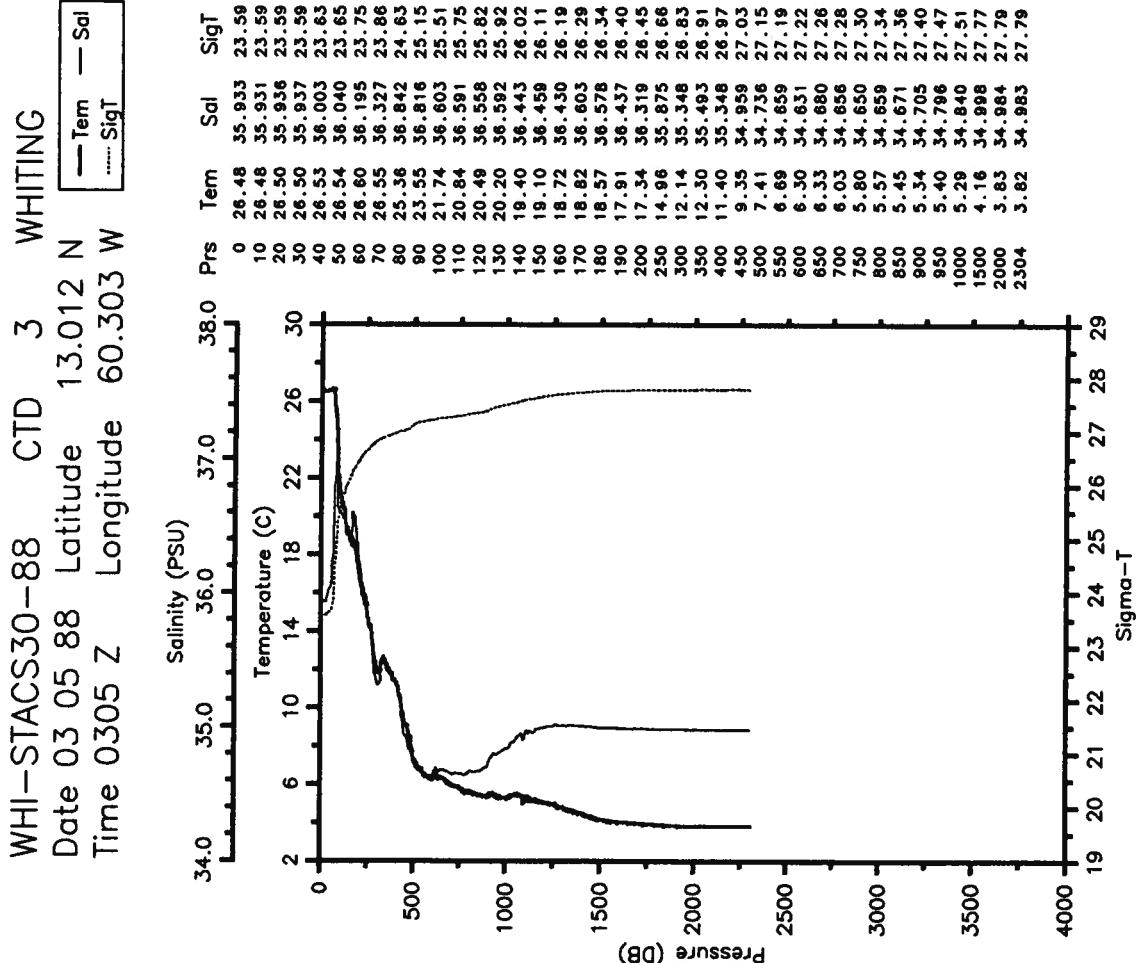


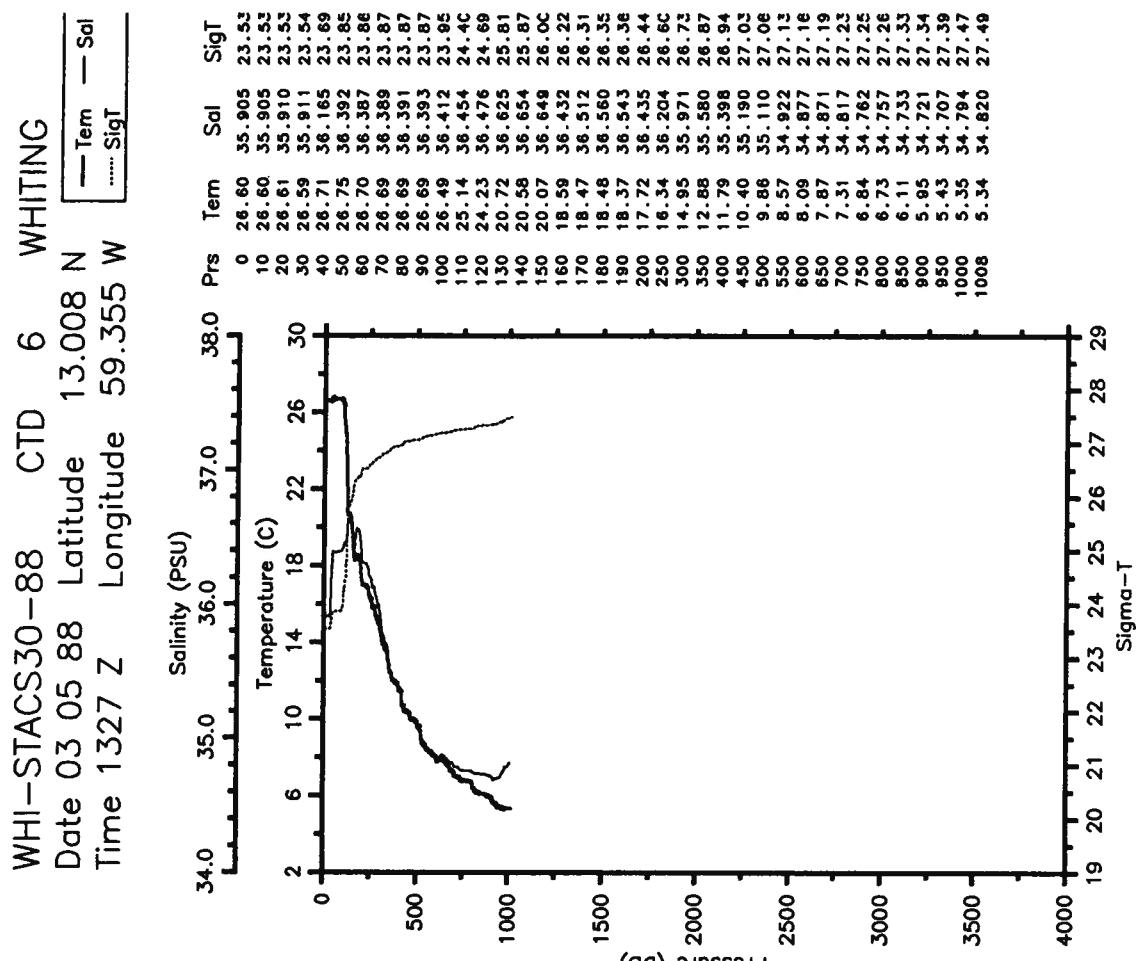
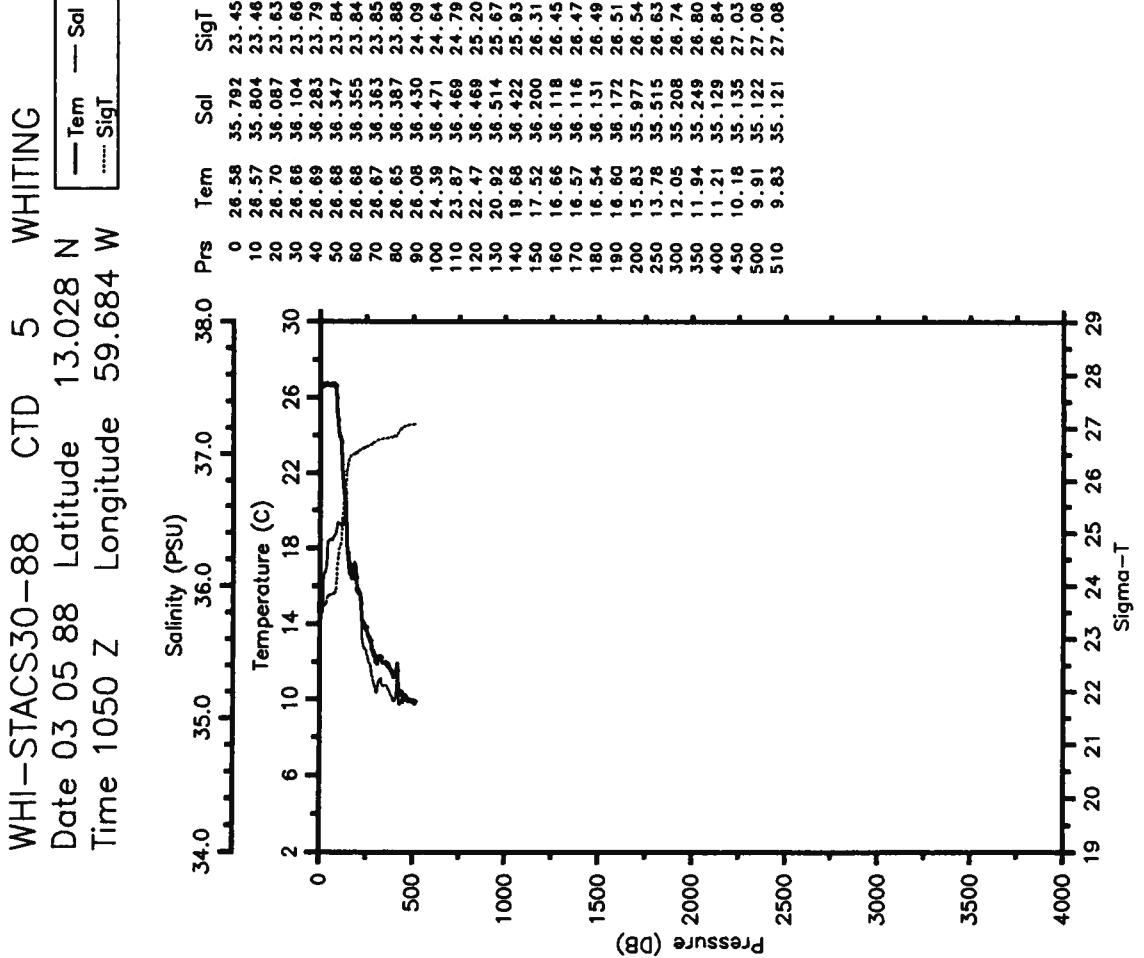


#### **APPENDIX B: CTD DATA**

Casts are presented by cruise and increasing cast number. Julian day and time, cruise number and vessel, and position are given at the top of each plot. Temperature, salinity and sigma-t profiles are shown for each cast.

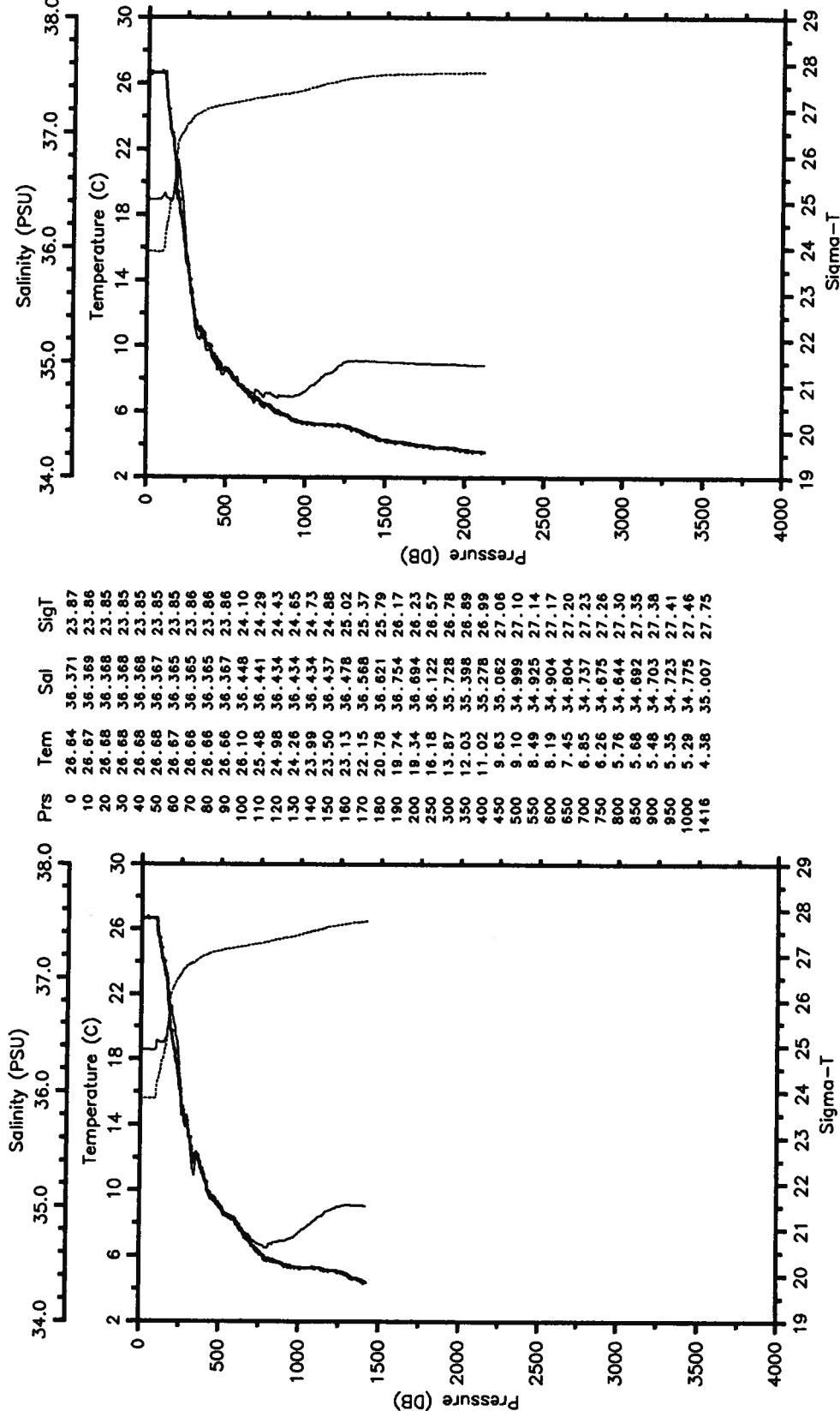






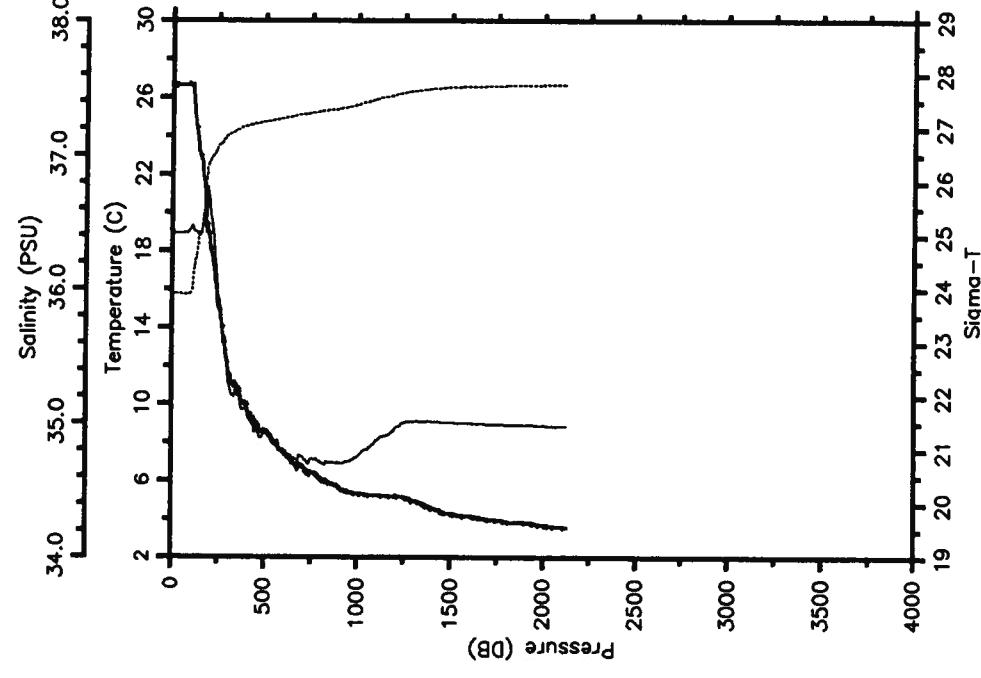
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 Time 1656 Z Longitude 58.968 W

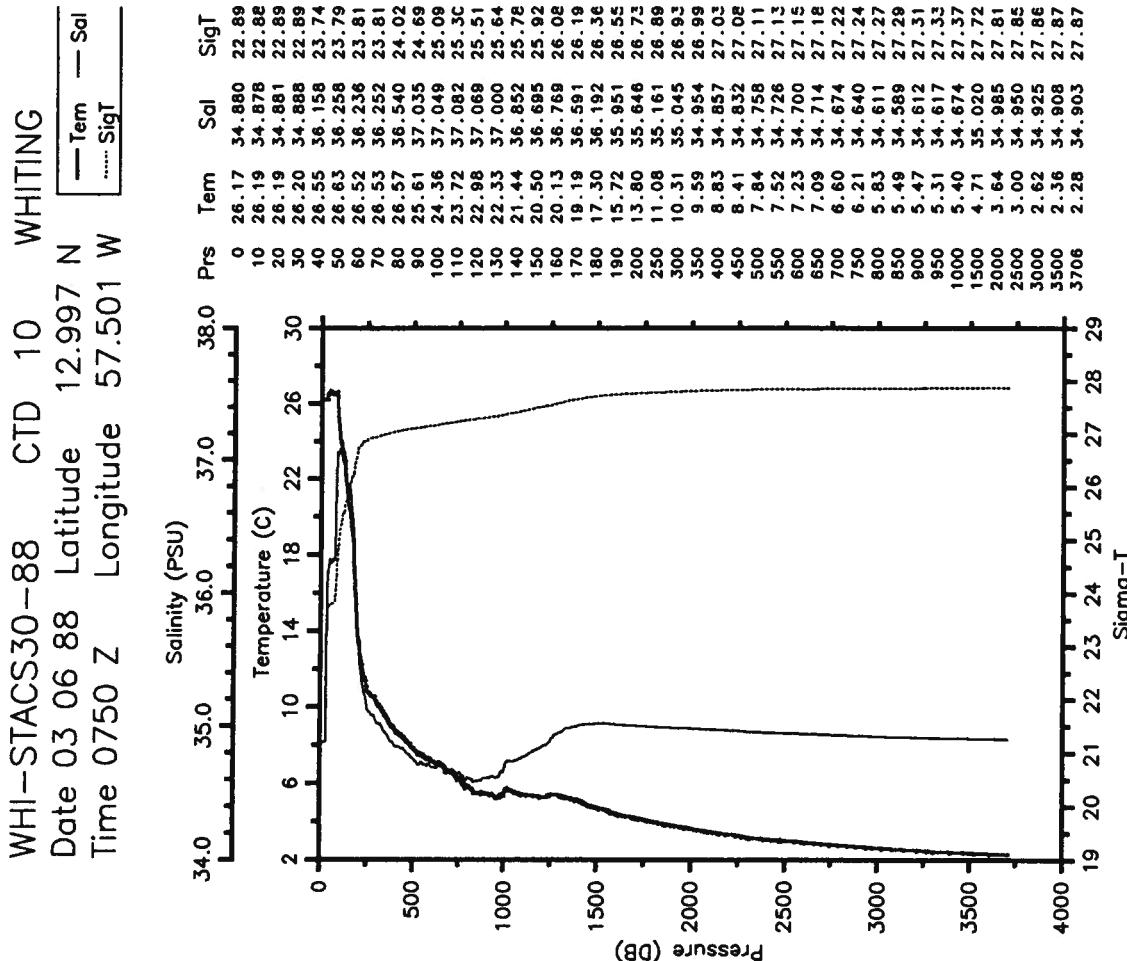
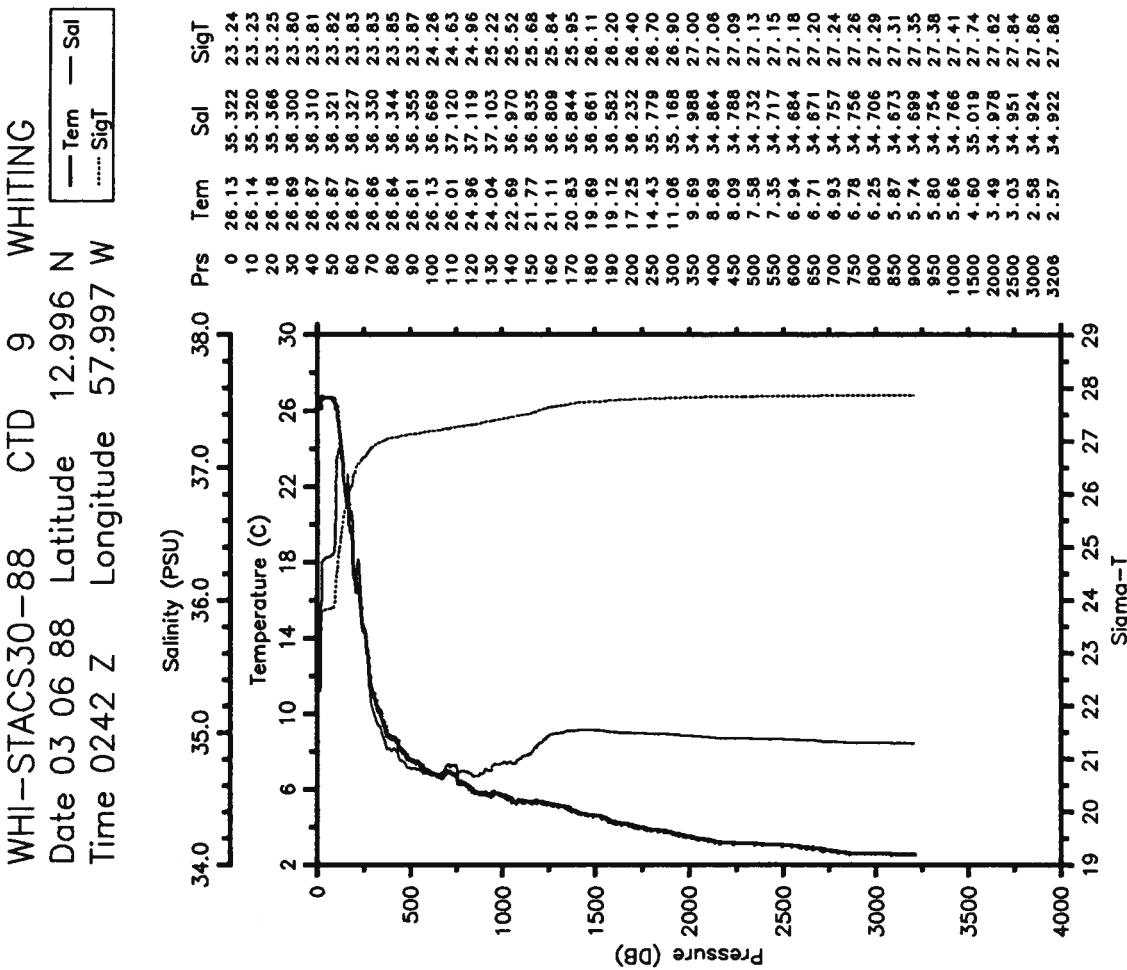
— Tem — Sal  
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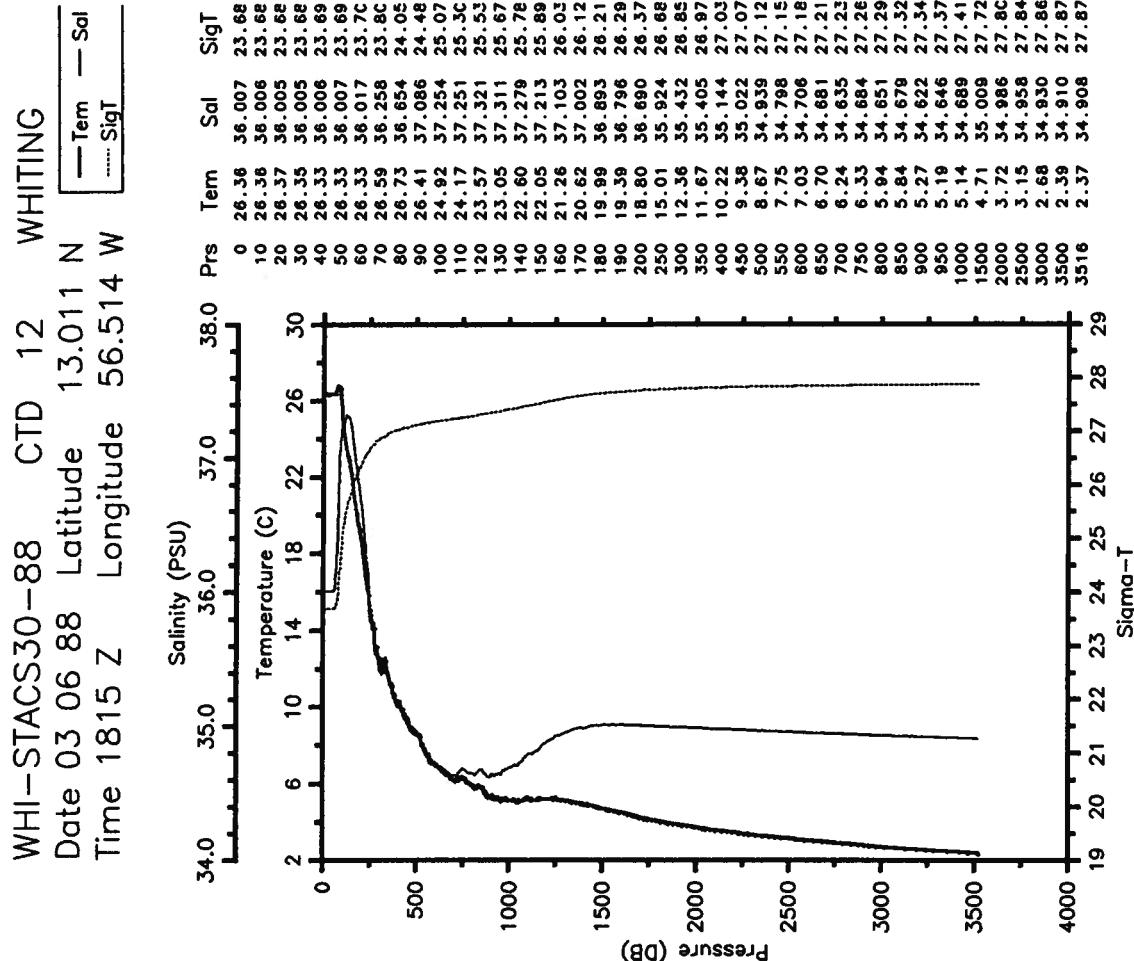
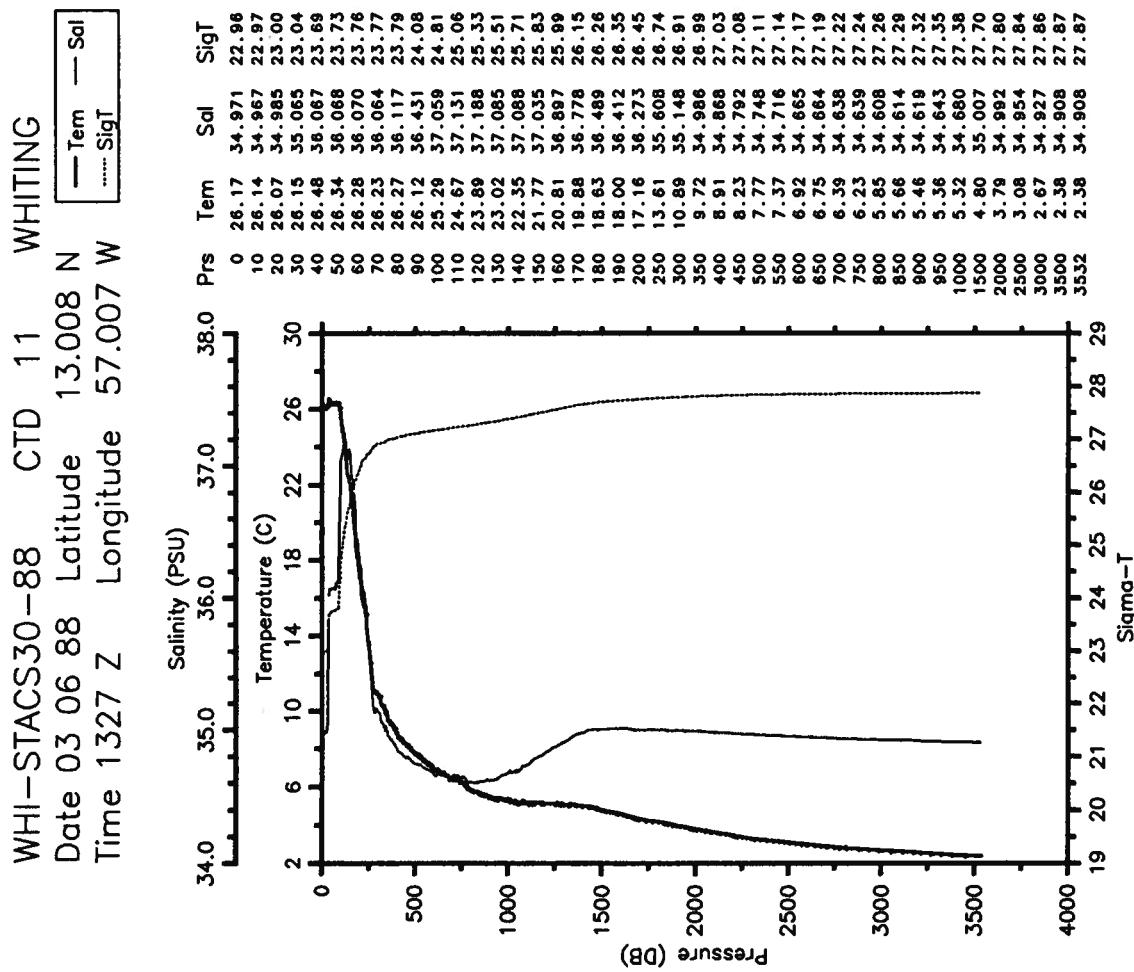


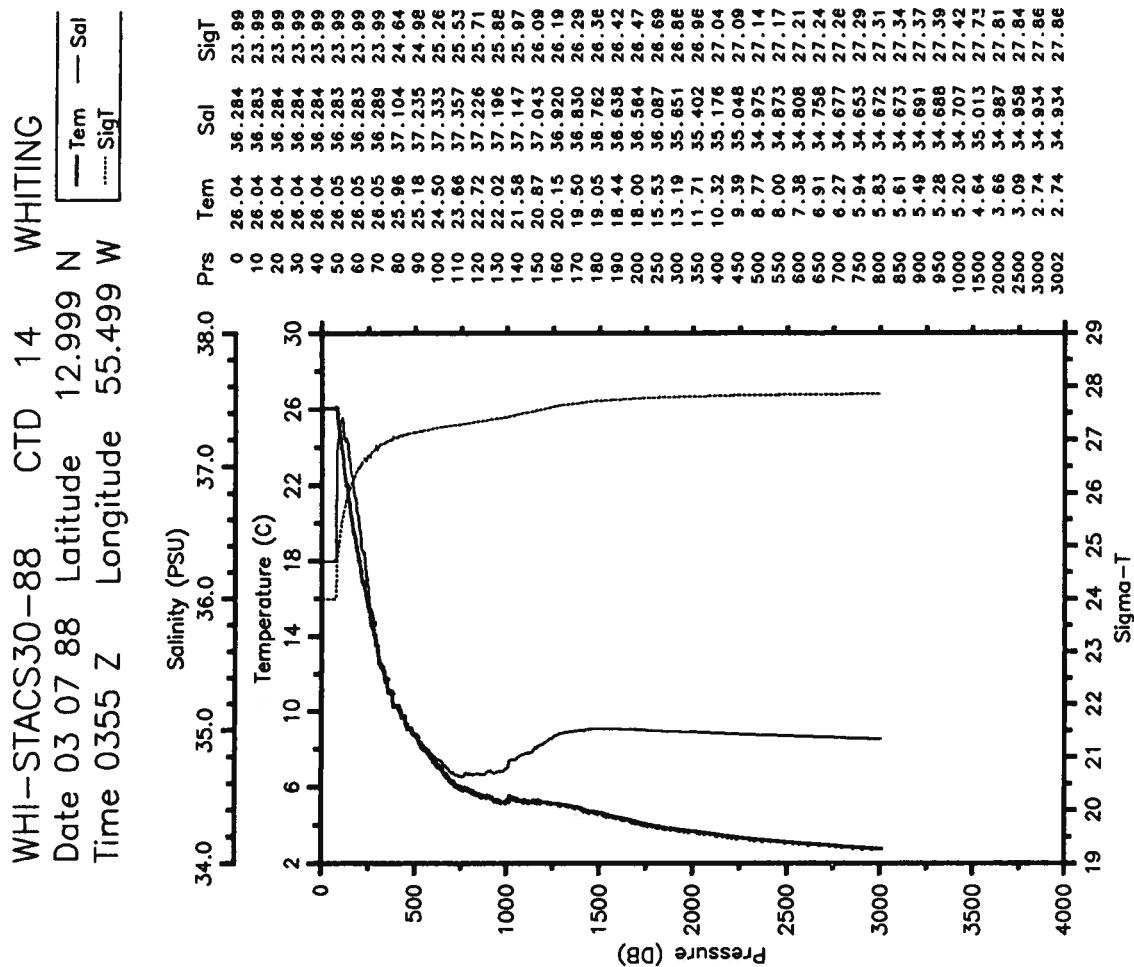
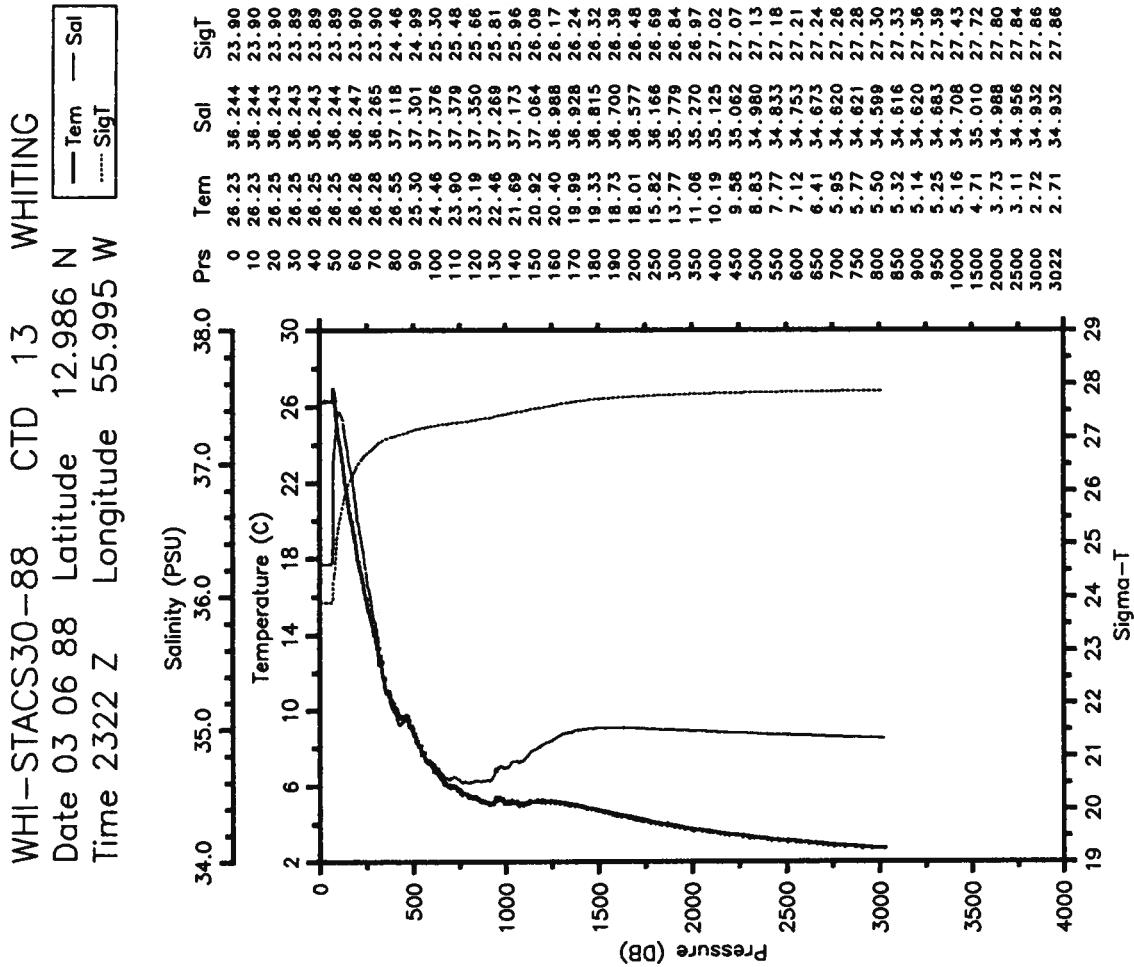
WHI-STACSS30-88 CTD 8 WHITING  
 Date 03 05 88 Latitude 12.992 N  
 Time 2055 Z Longitude 58.588 W

— Tem — Sal  
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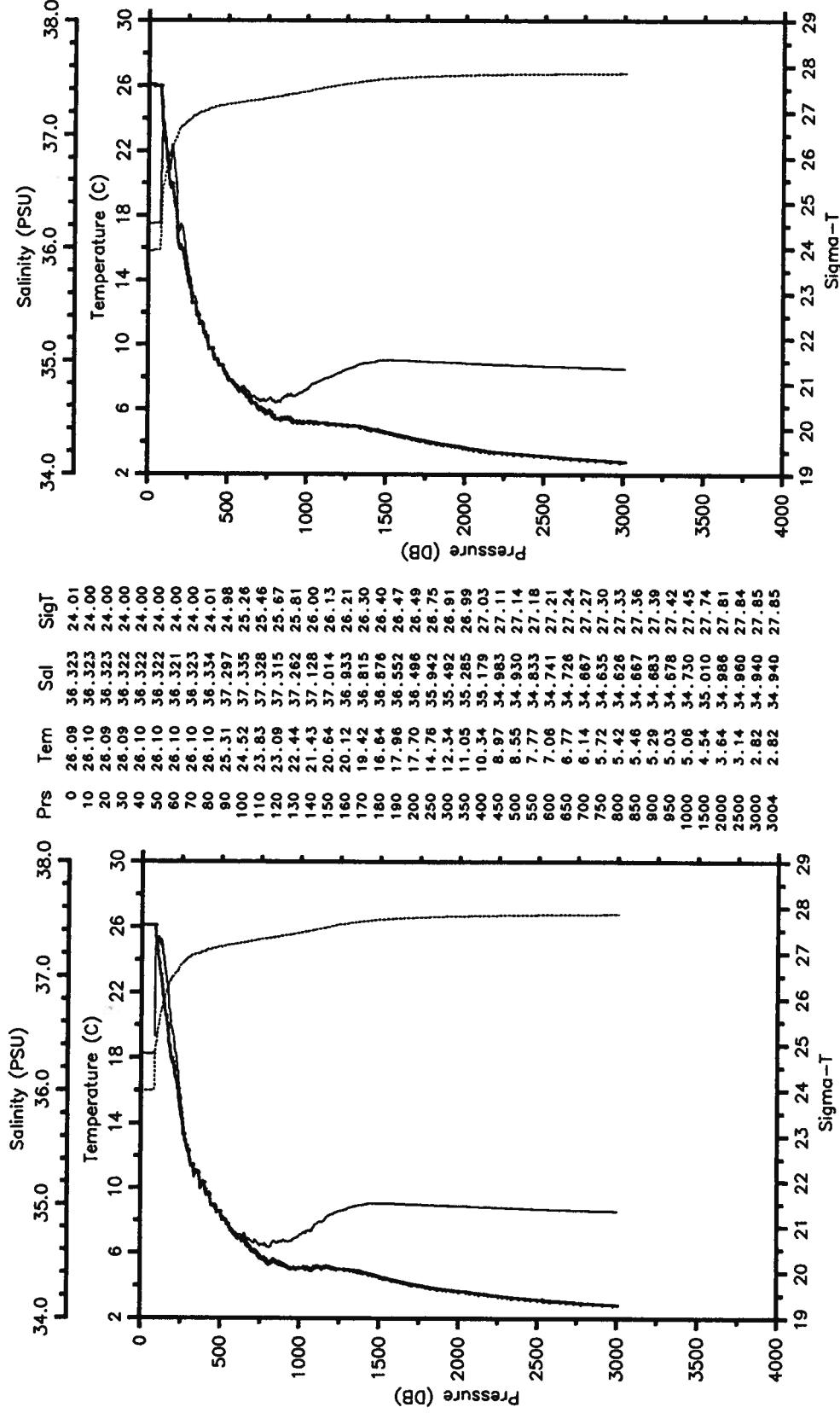


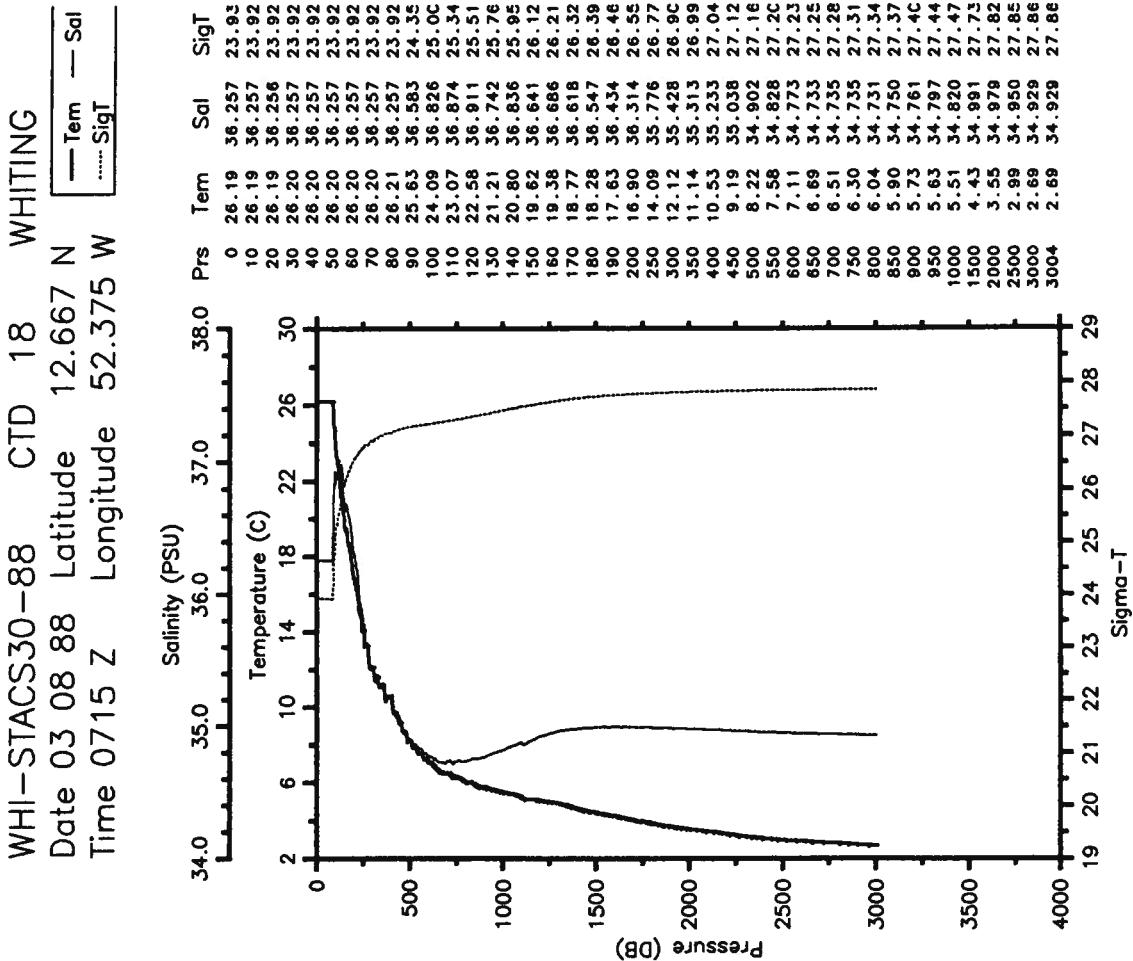
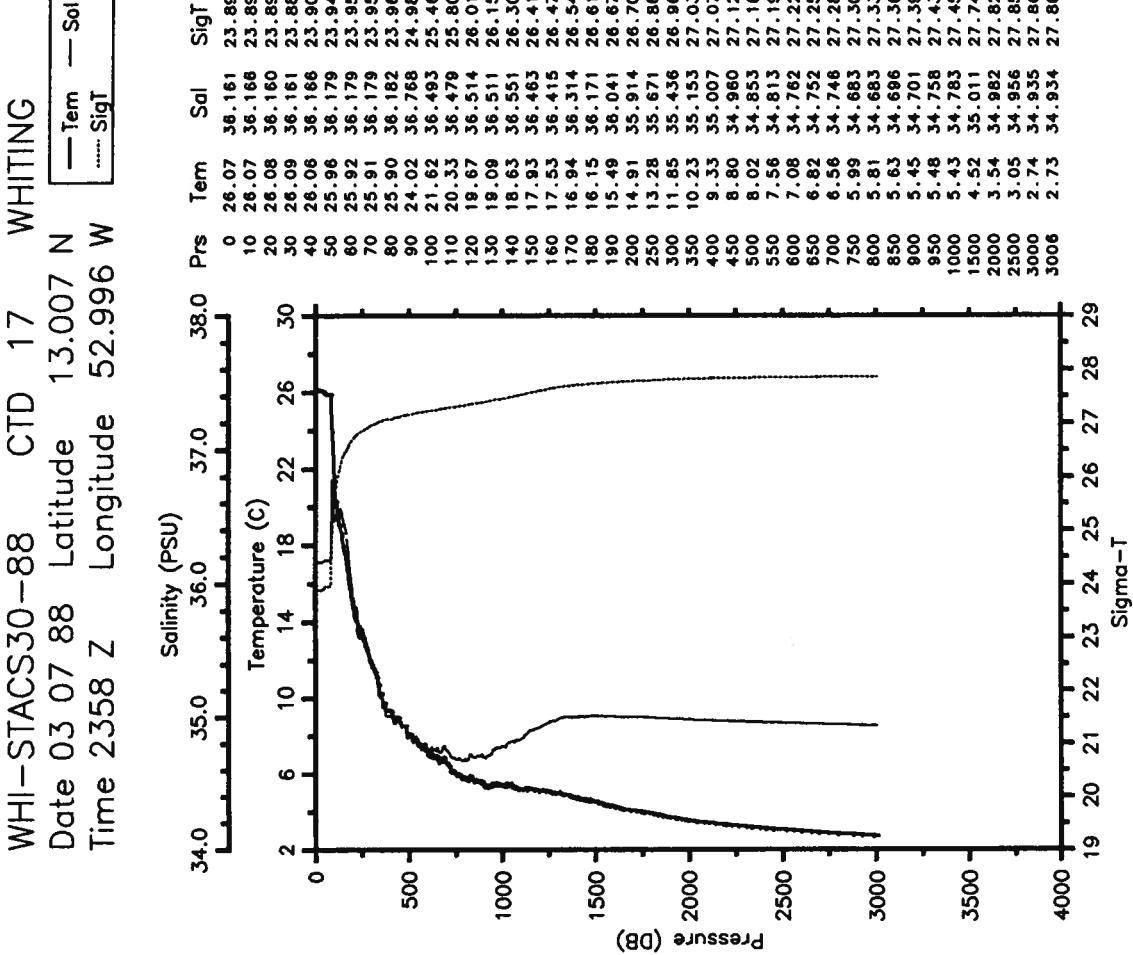




WHI-STACCS30-88 CTD 15 WHITING  
 Date 03 07 88 Latitude 13.000 N  
 Time 0852 Z Longitude 55.002 W

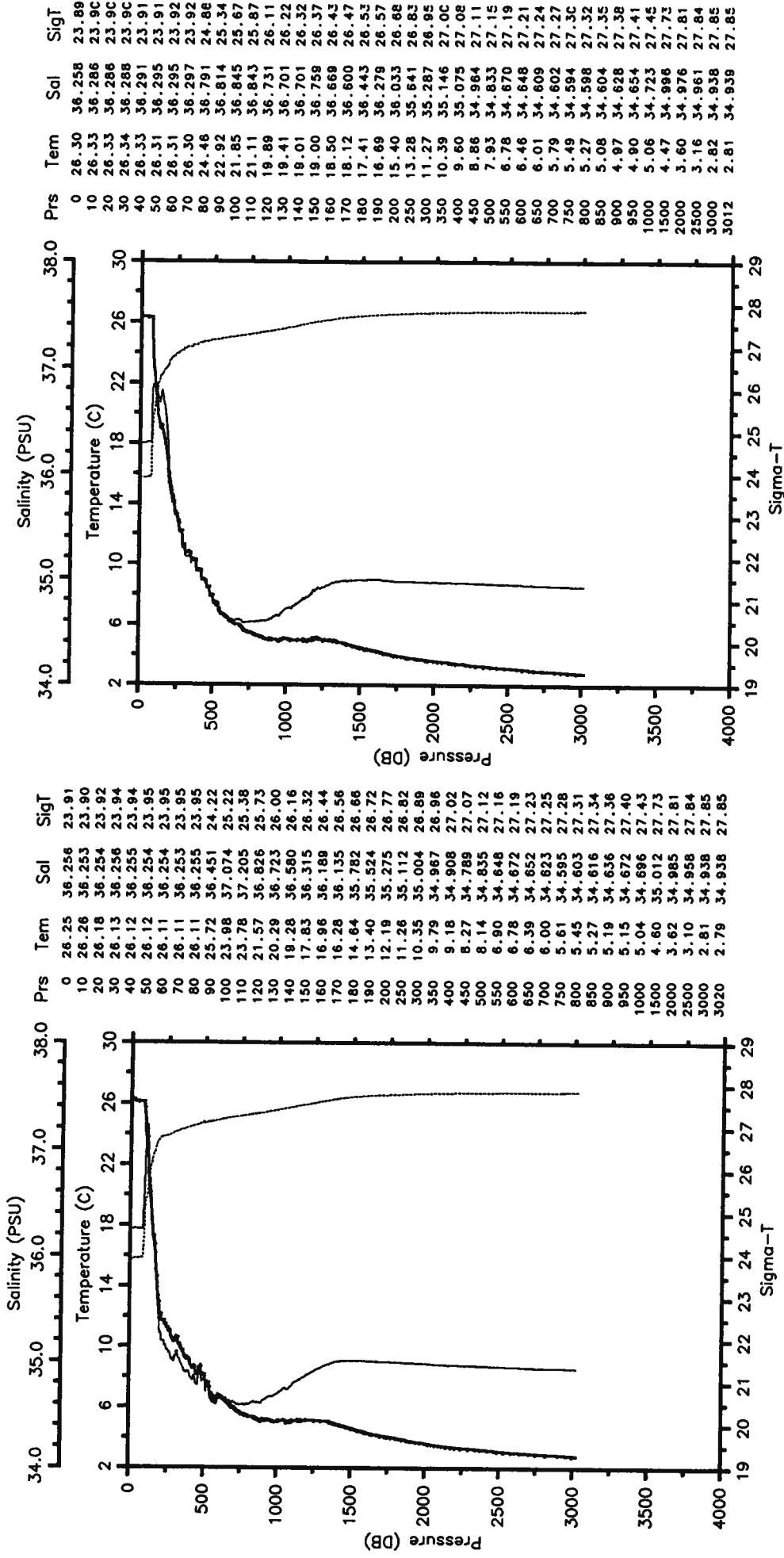
WHI-STACCS30-88 CTD 16 WHITING  
 Date 03 07 88 Latitude 13.006 N  
 Time 1627 Z Longitude 53.992 W

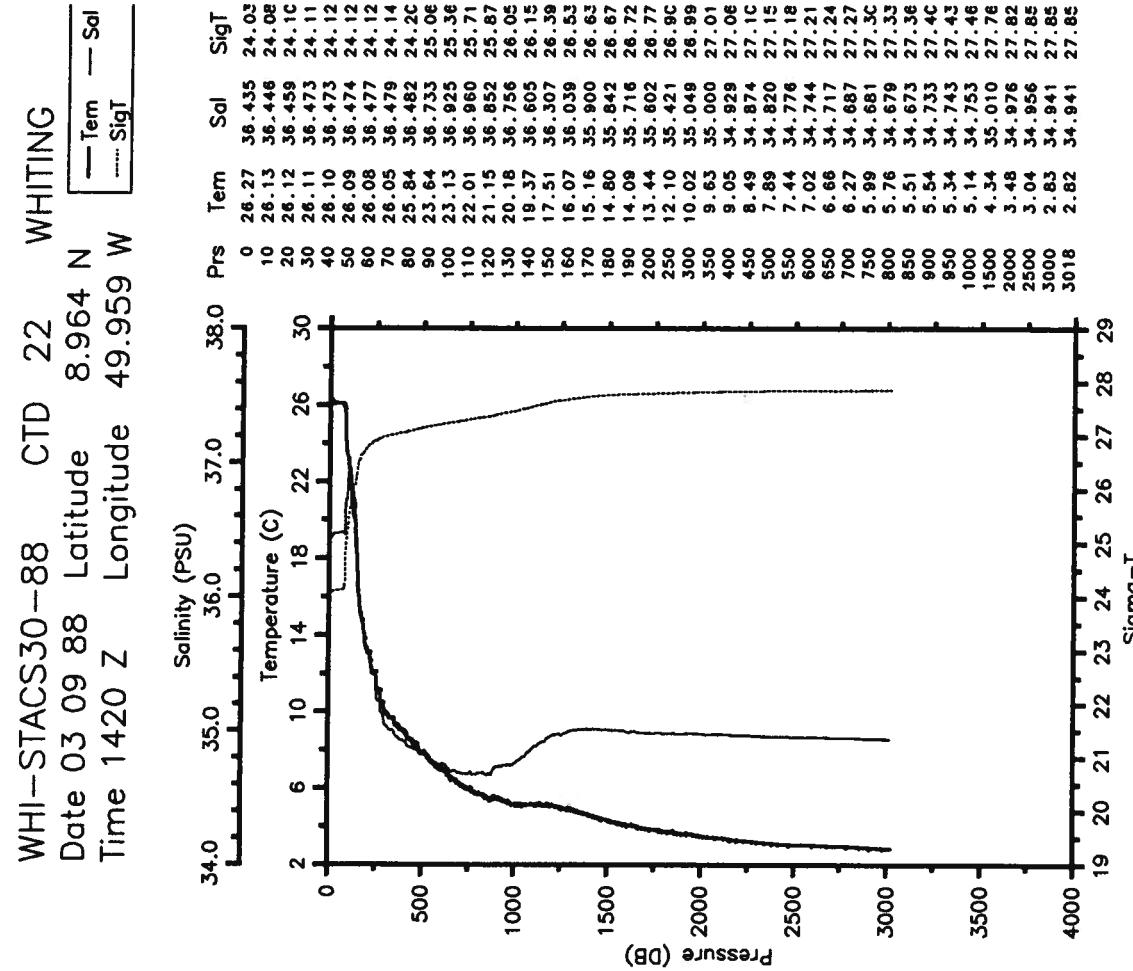
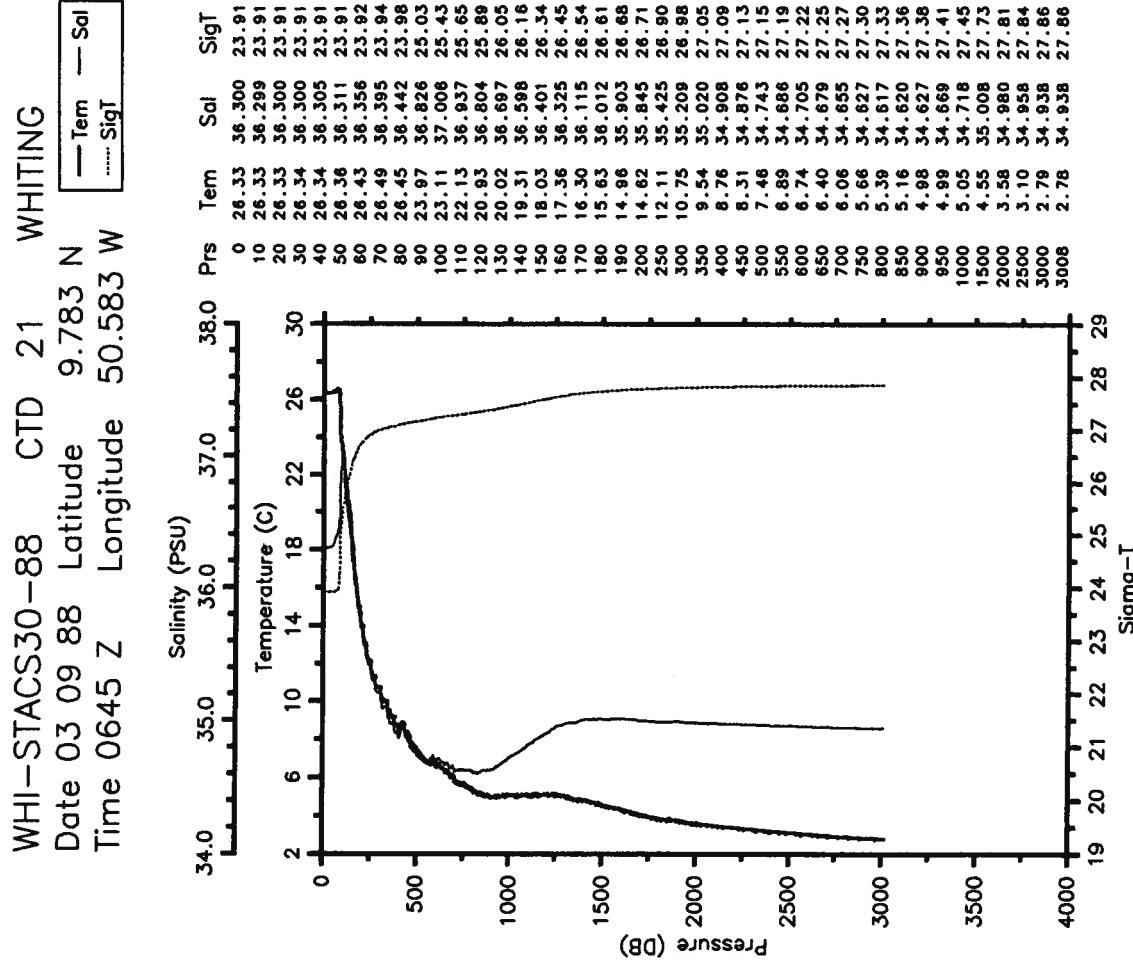


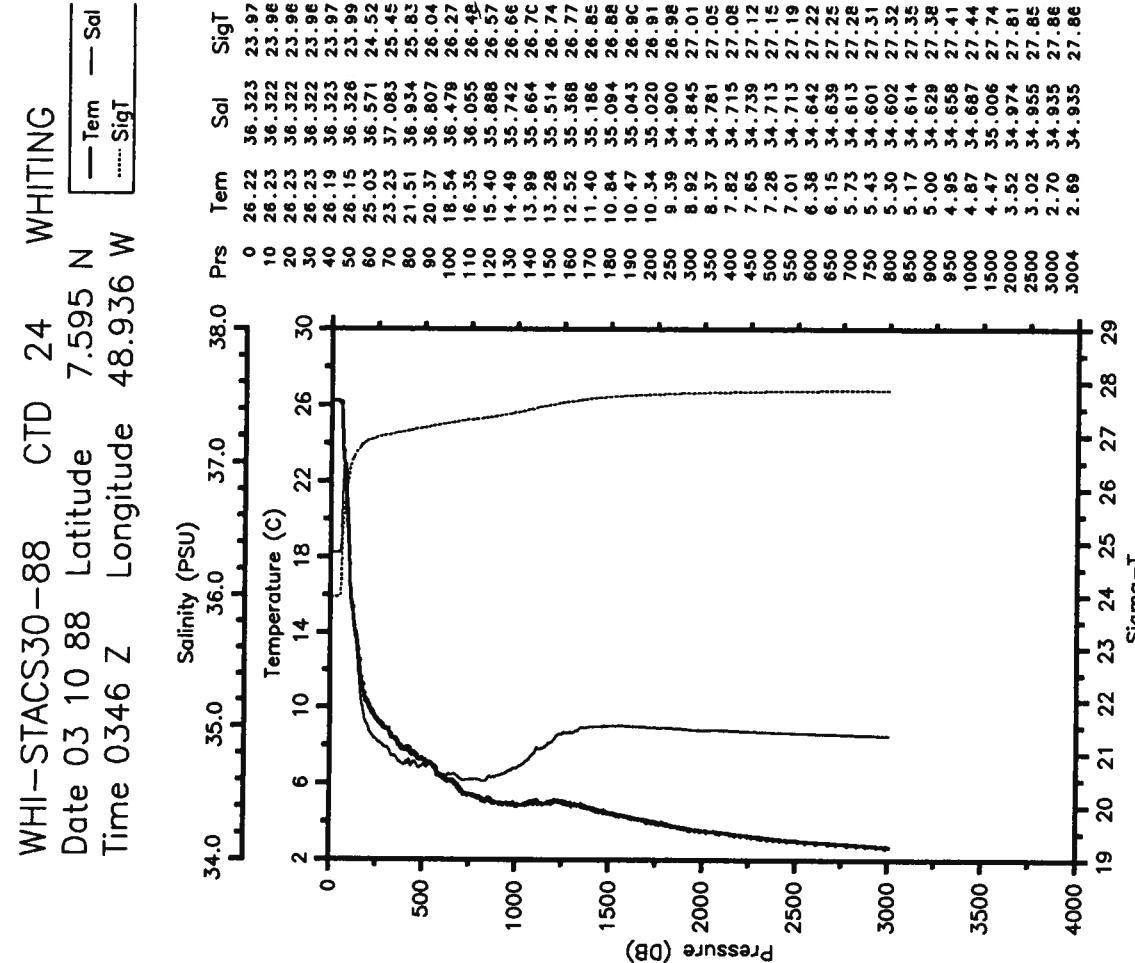
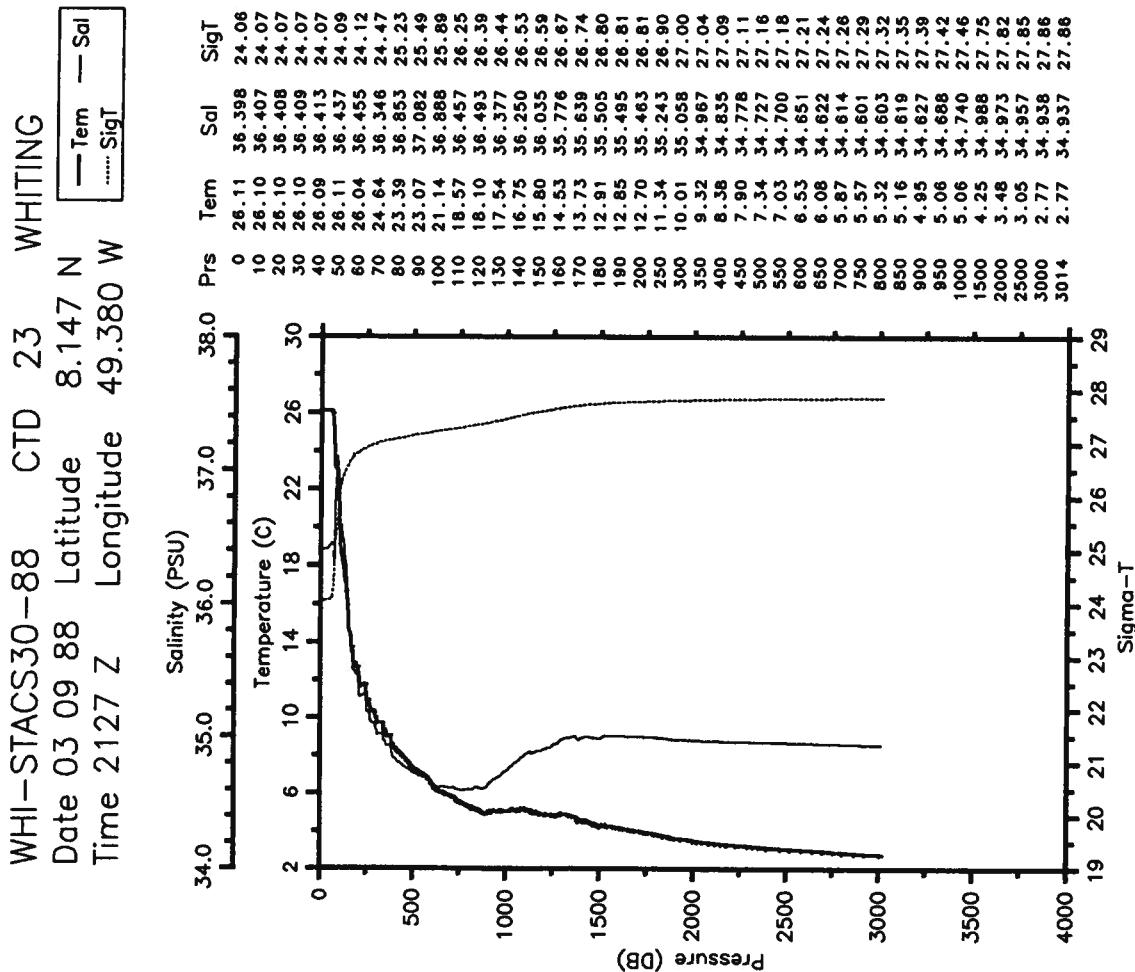


WHI-STAC30-88 CTD 19 WHITING  
 Date 03 08 88 Latitude 11.410 N  
 Time 1527 Z Longitude 51.787 W

WHI-STAC30-88 CTD 20 WHITING  
 Date 03 08 88 Latitude 10.571 N  
 Time 2310 Z Longitude 51.190 W

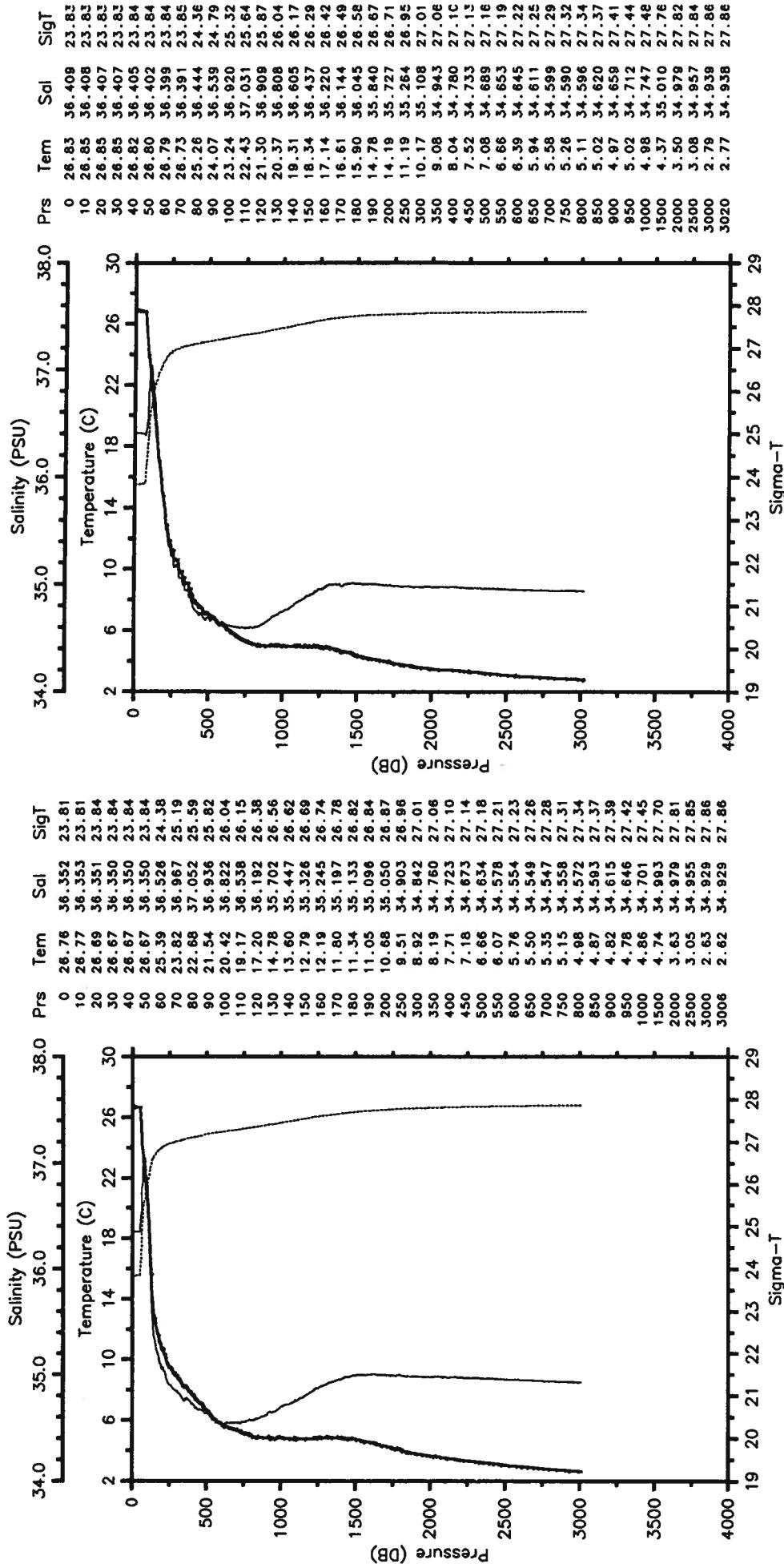




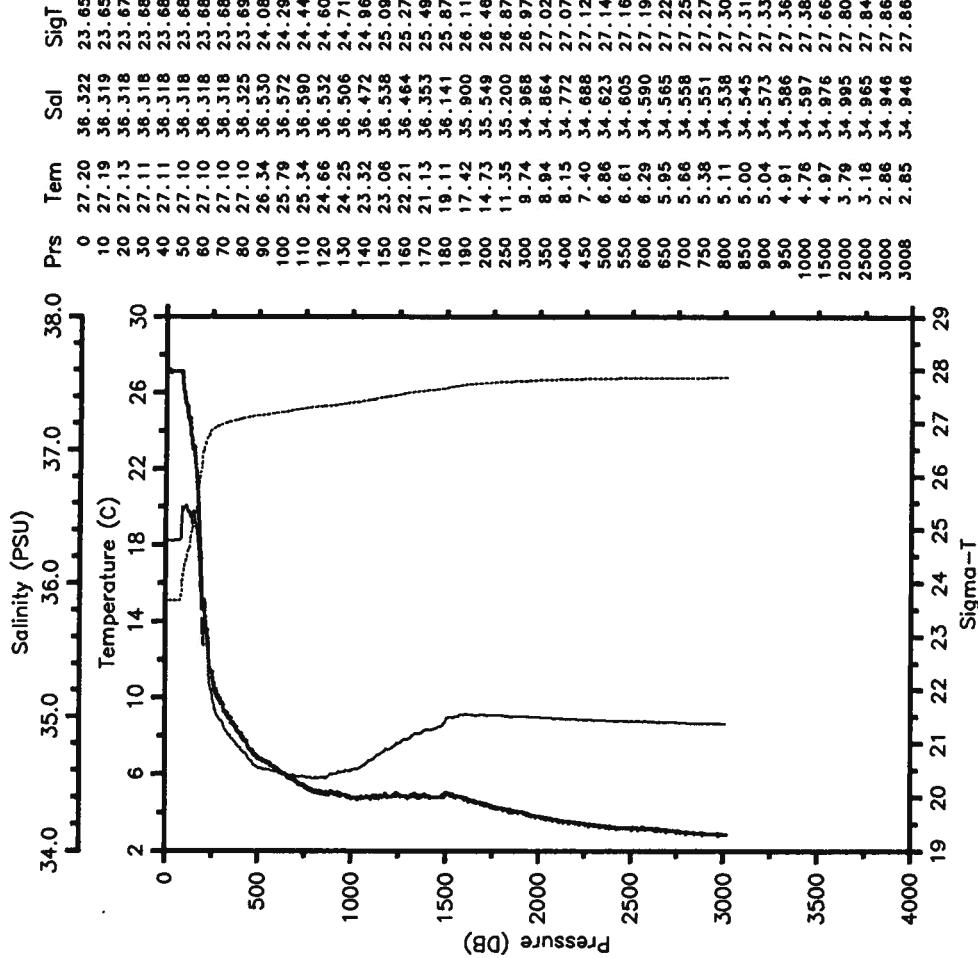


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 Time 0945 Z      Longitude 48.485 W

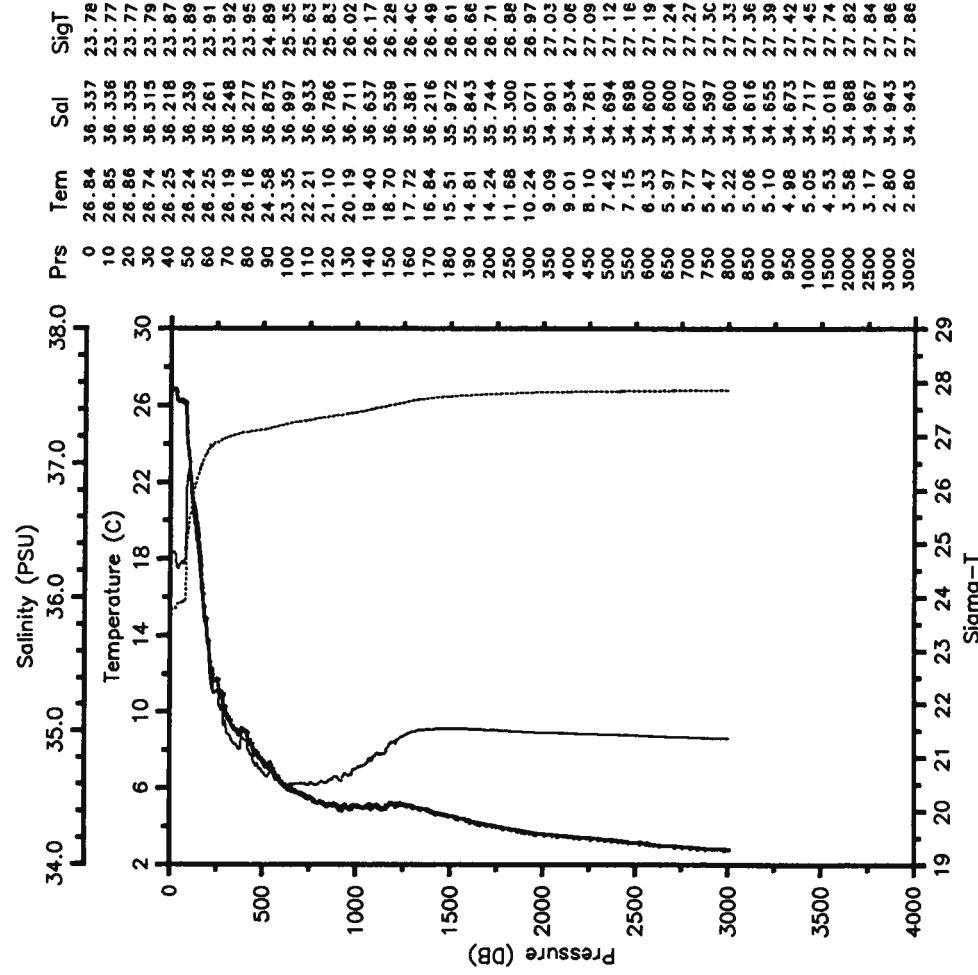
WHI-STACS30-88      CTD    26      WHITING  
 Date 03 10 88      Latitude 7.953 N  
 Time 2158 Z      Longitude 50.259 W



WHI-STACS30-88 CTD 27 WHITING  
 Date 03 11 88 Latitude 8.903 N  
 Time 1107 Z Longitude 52.086 W

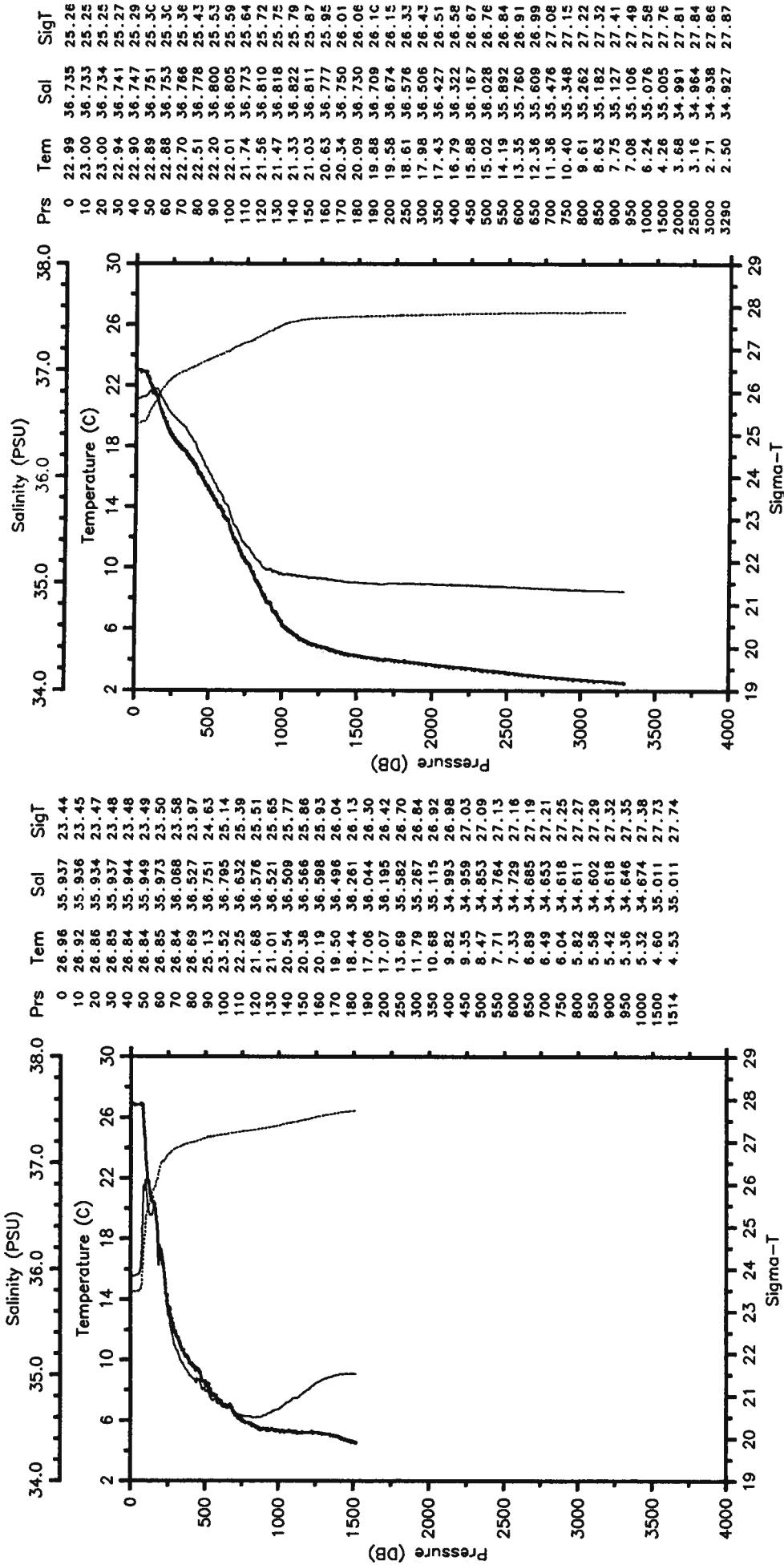


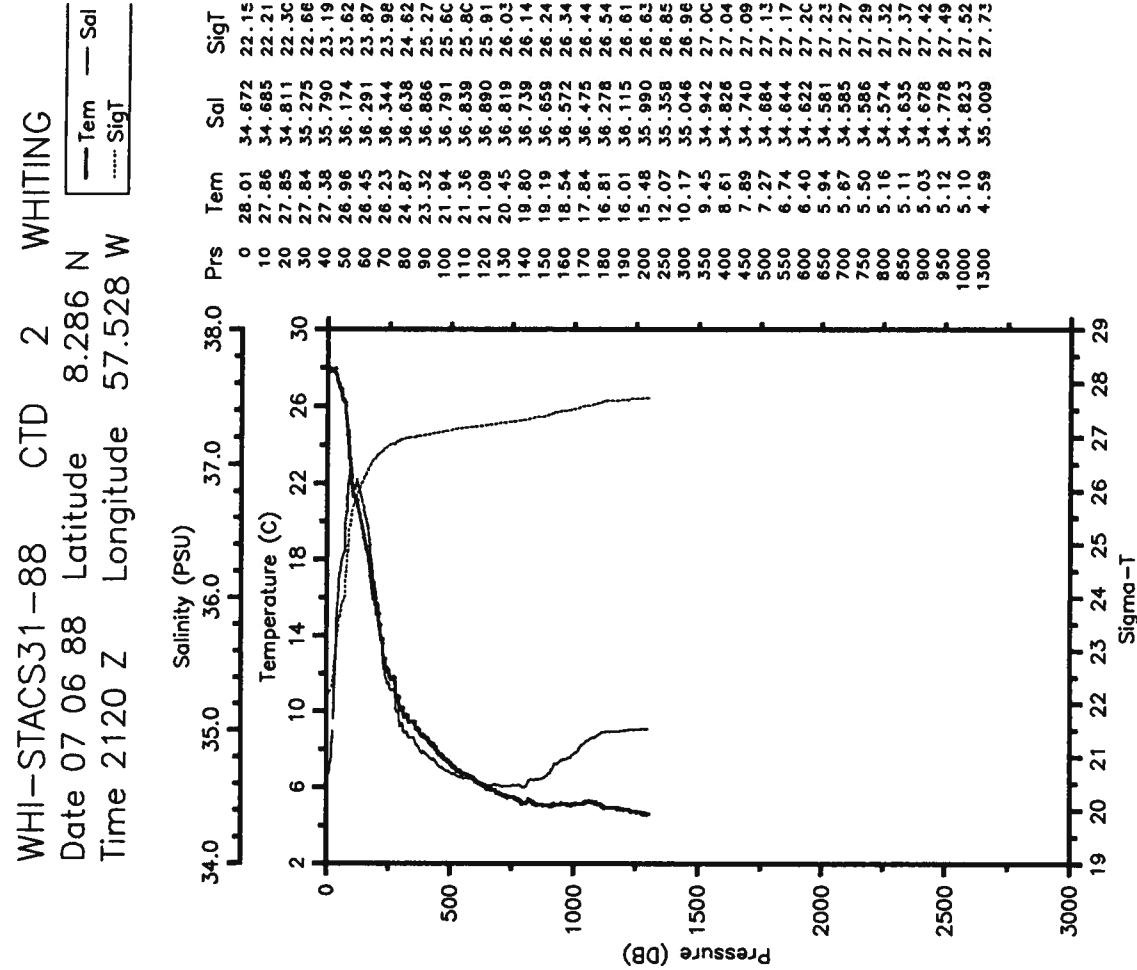
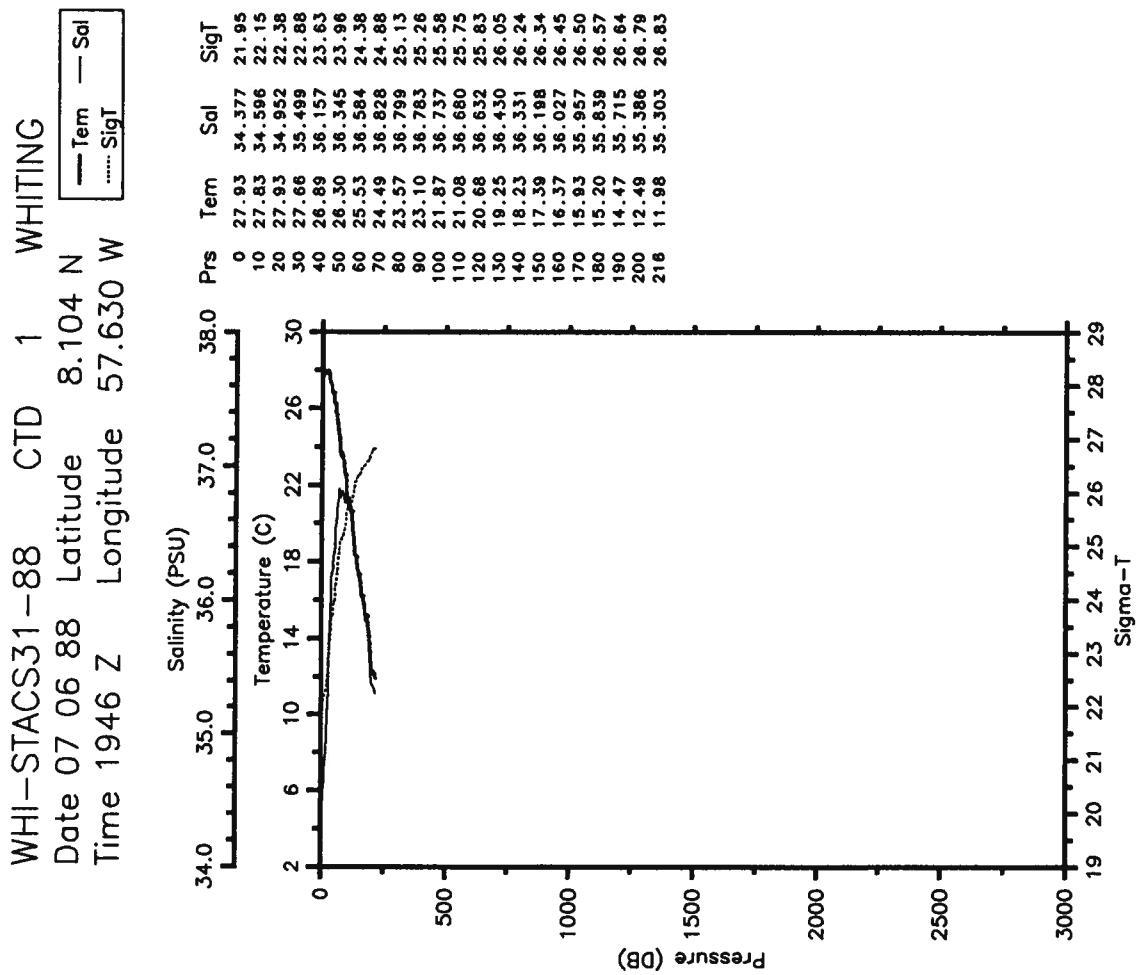
WHI-STACS30-88 CTD 28 WHITING  
 Date 03 11 88 Latitude 9.890 N  
 Time 2338 Z Longitude 53.887 W

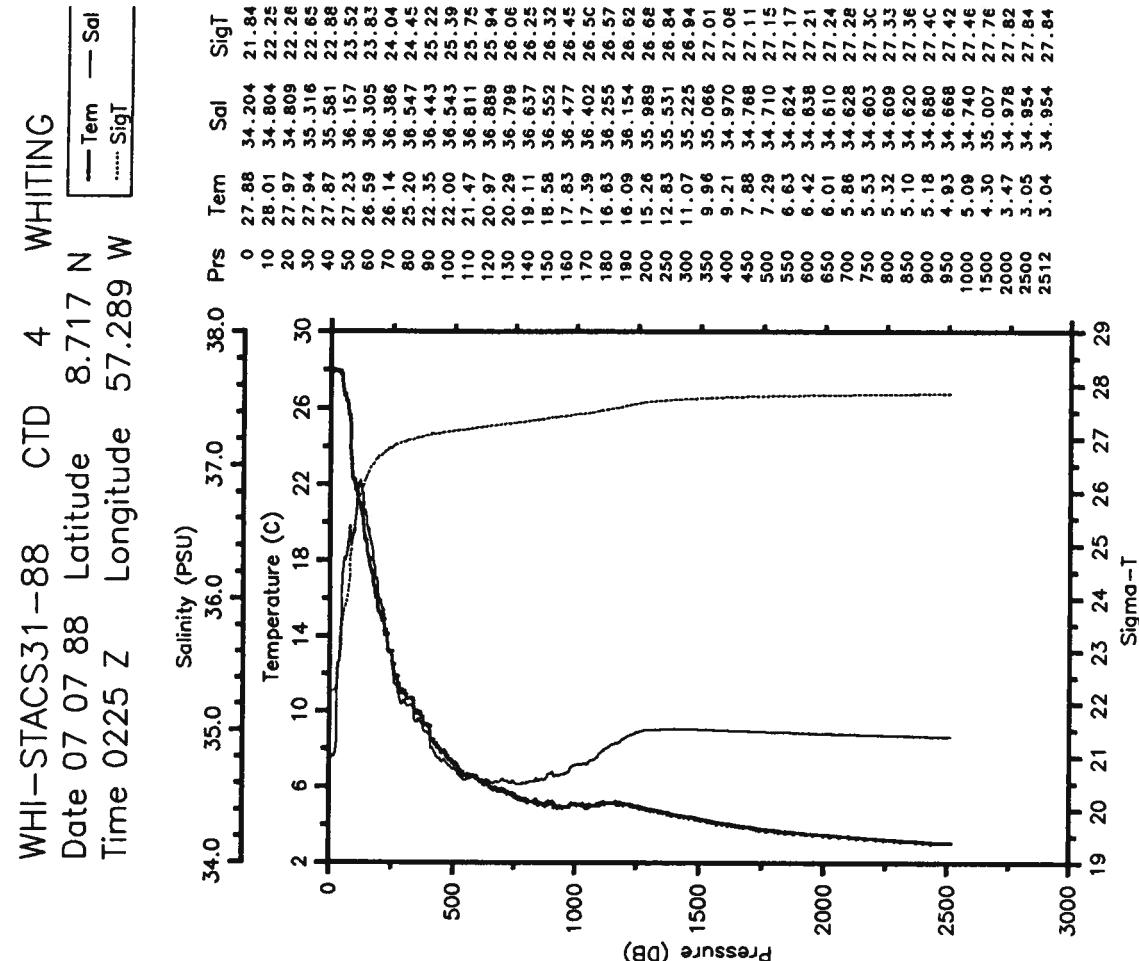
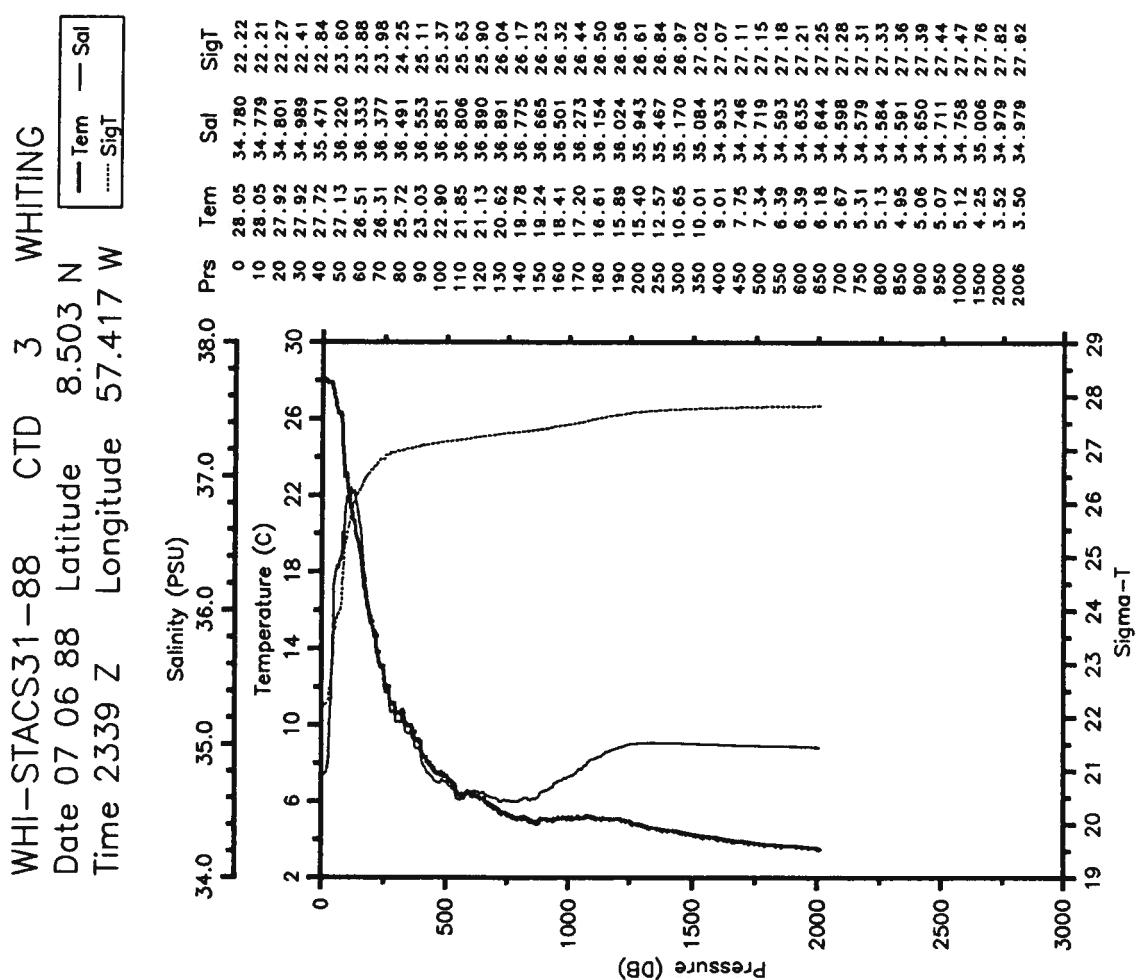


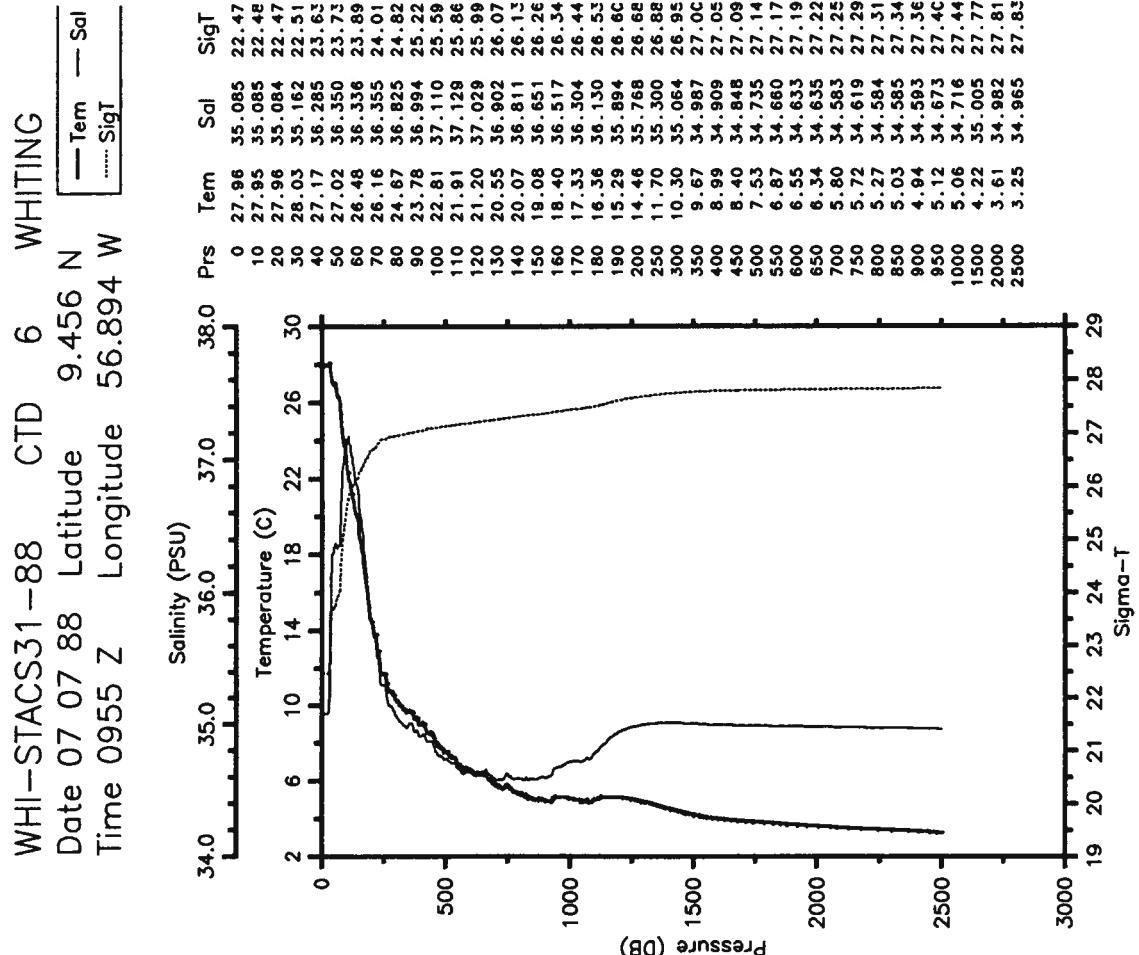
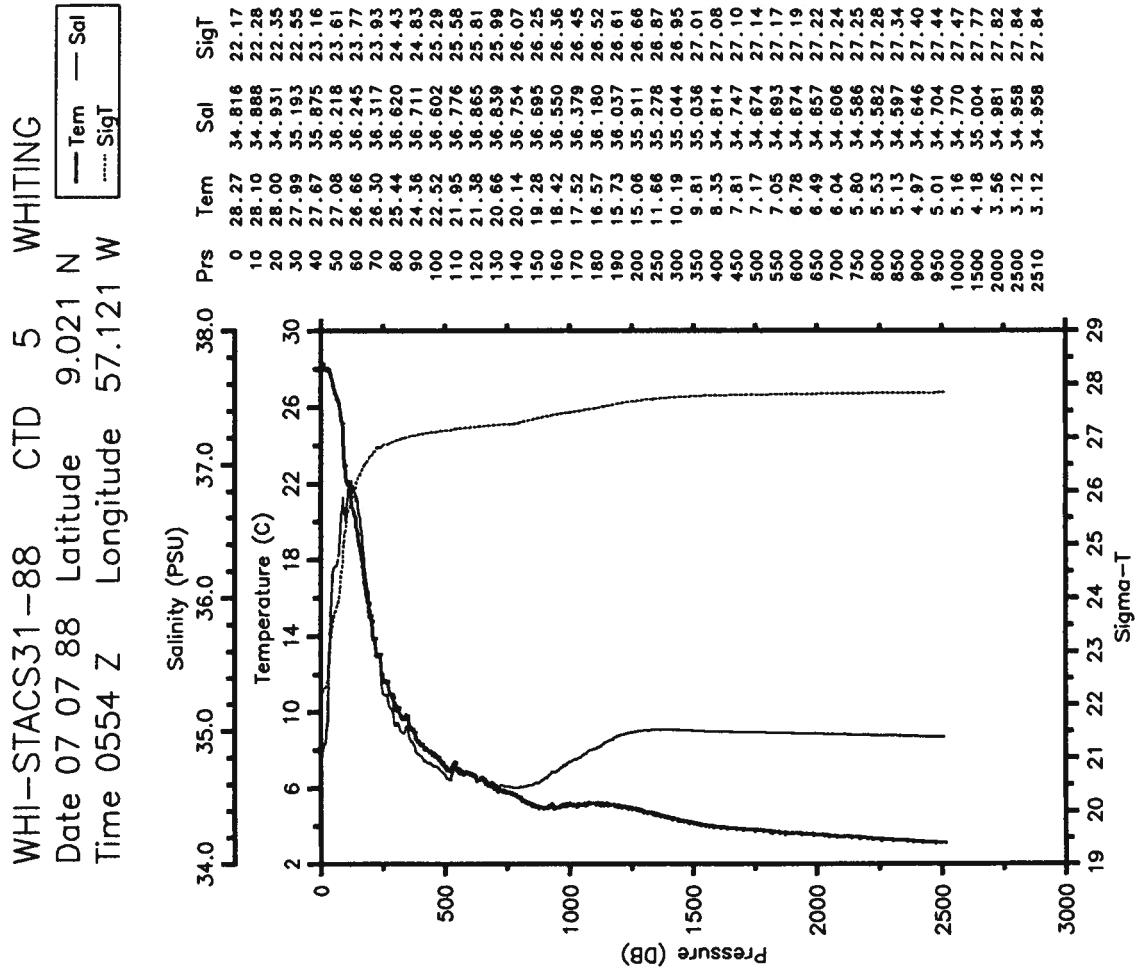
WHI—STACS30—88 CTD 29 WHITING  
 Date 03 12 88 Latitude 10.898 N  
 Time 1158 Z Longitude 55.656 W

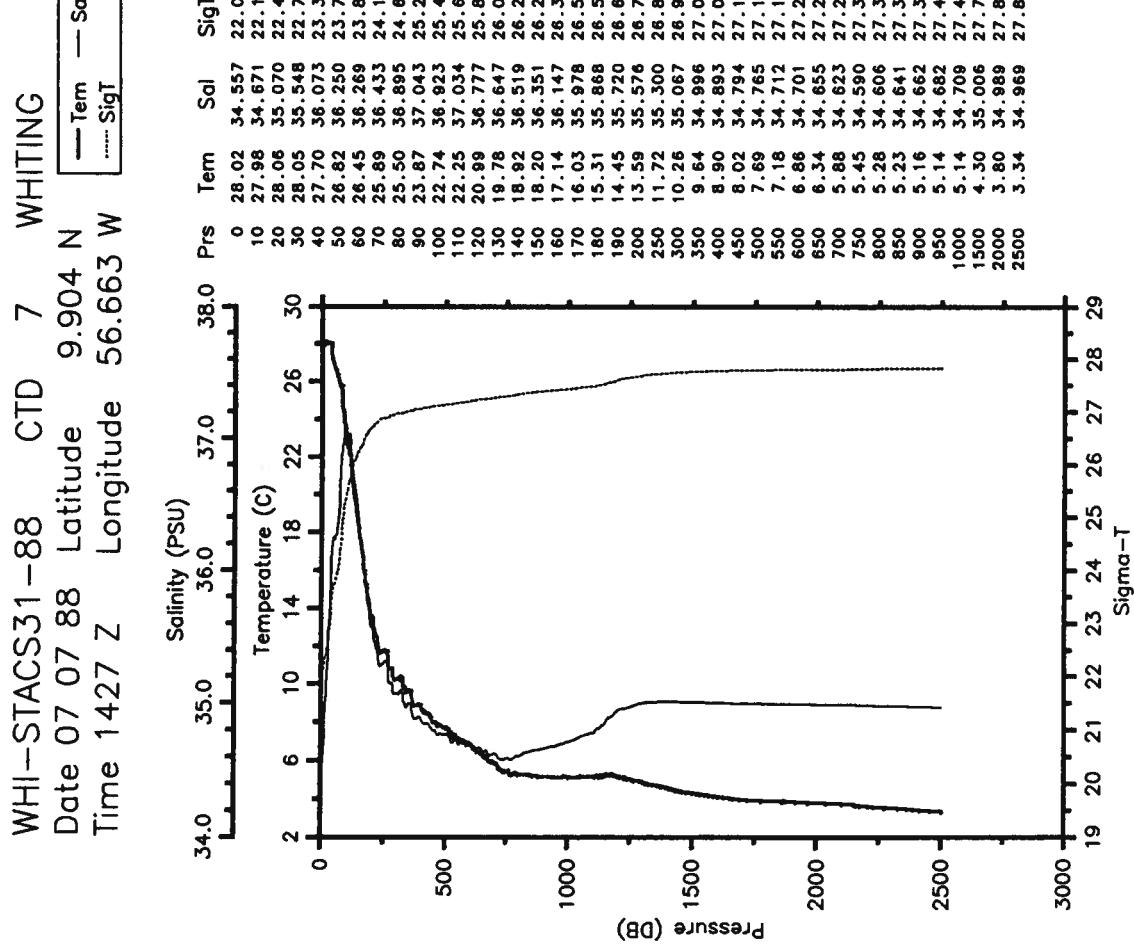
WHI—STACS30—88 CTD 30 WHITING  
 Date 03 20 88 Latitude 26.452 N  
 Time 2328 Z Longitude 75.528 W

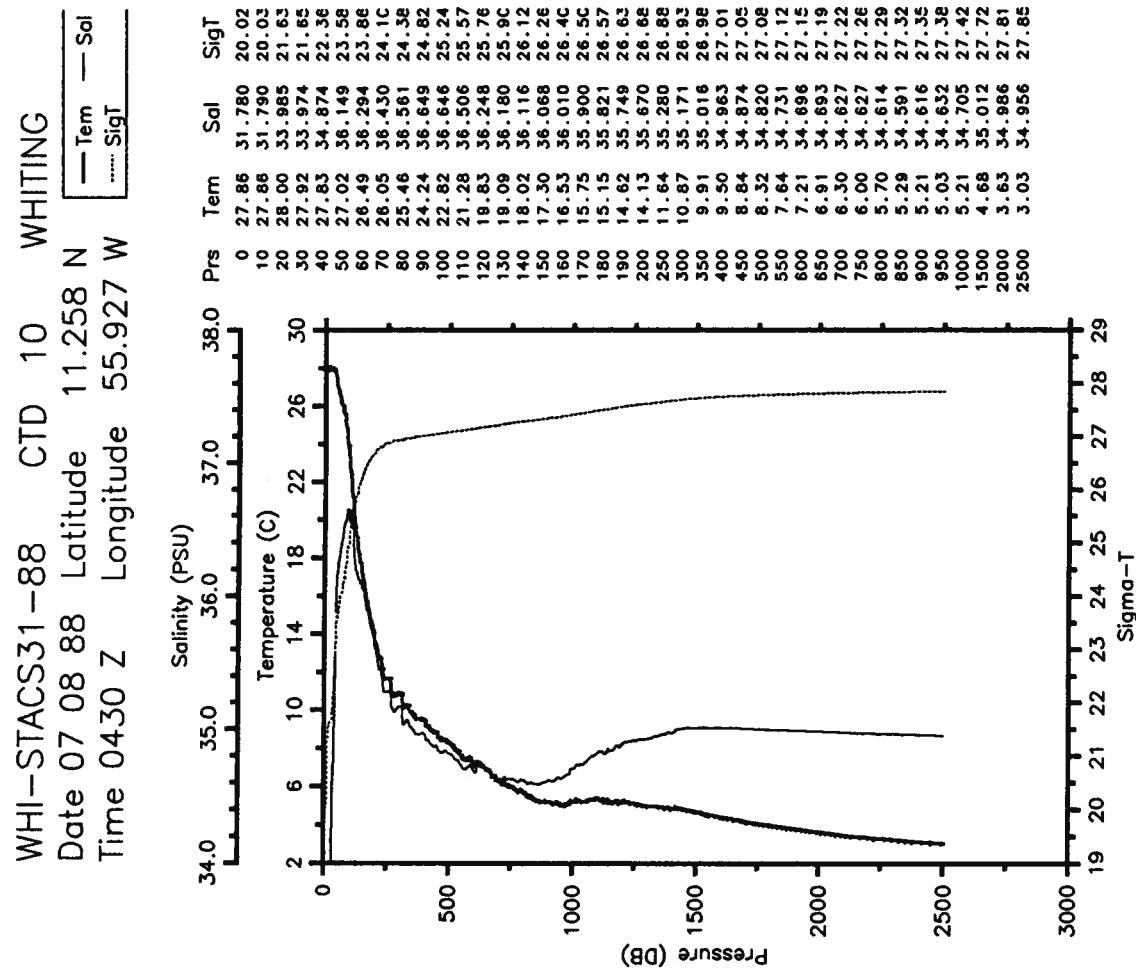
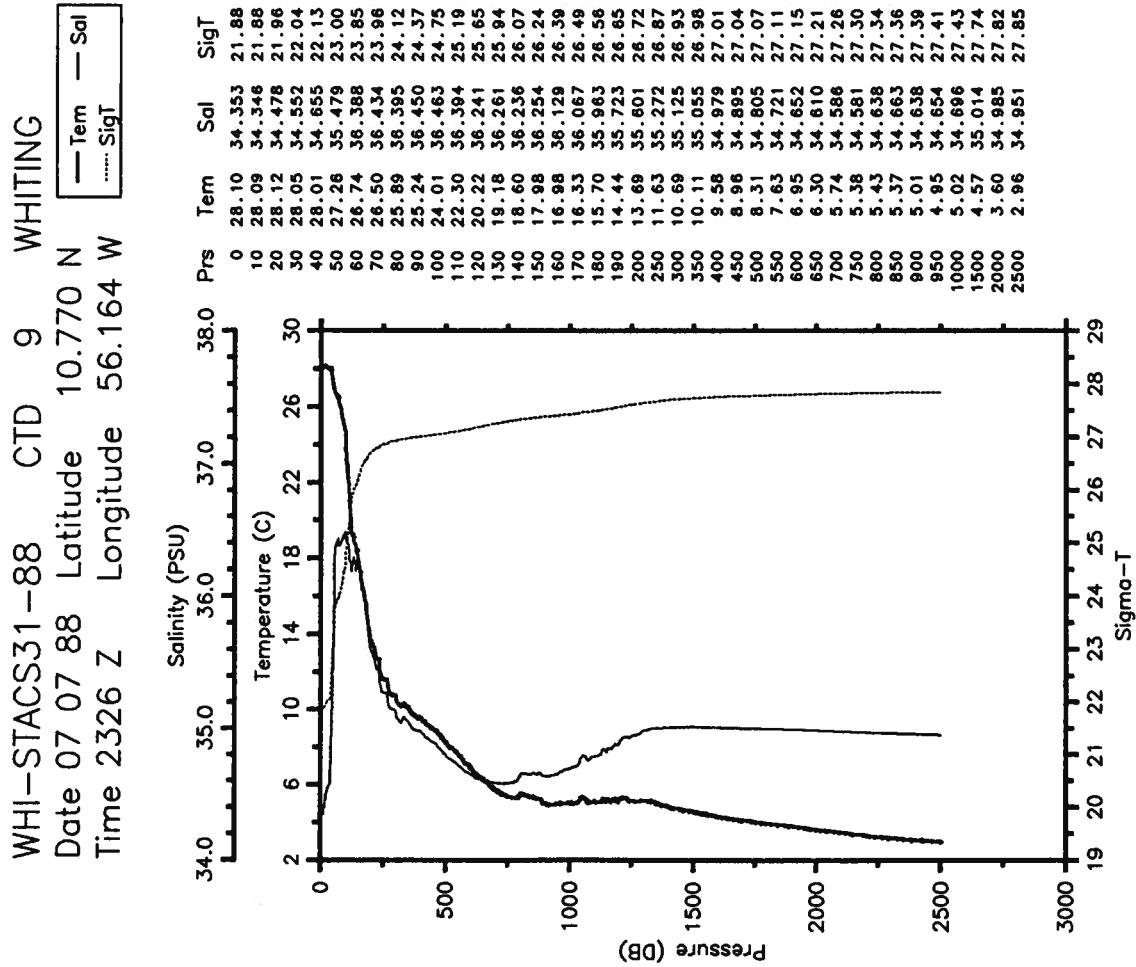






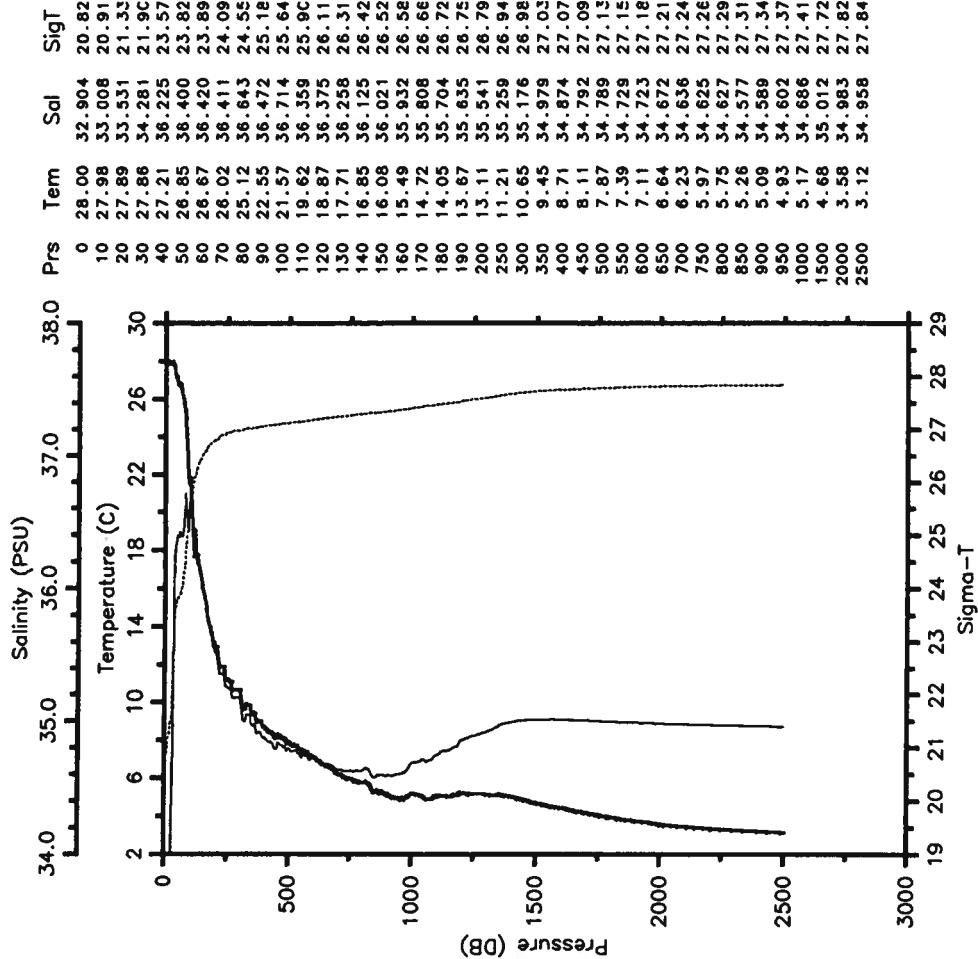
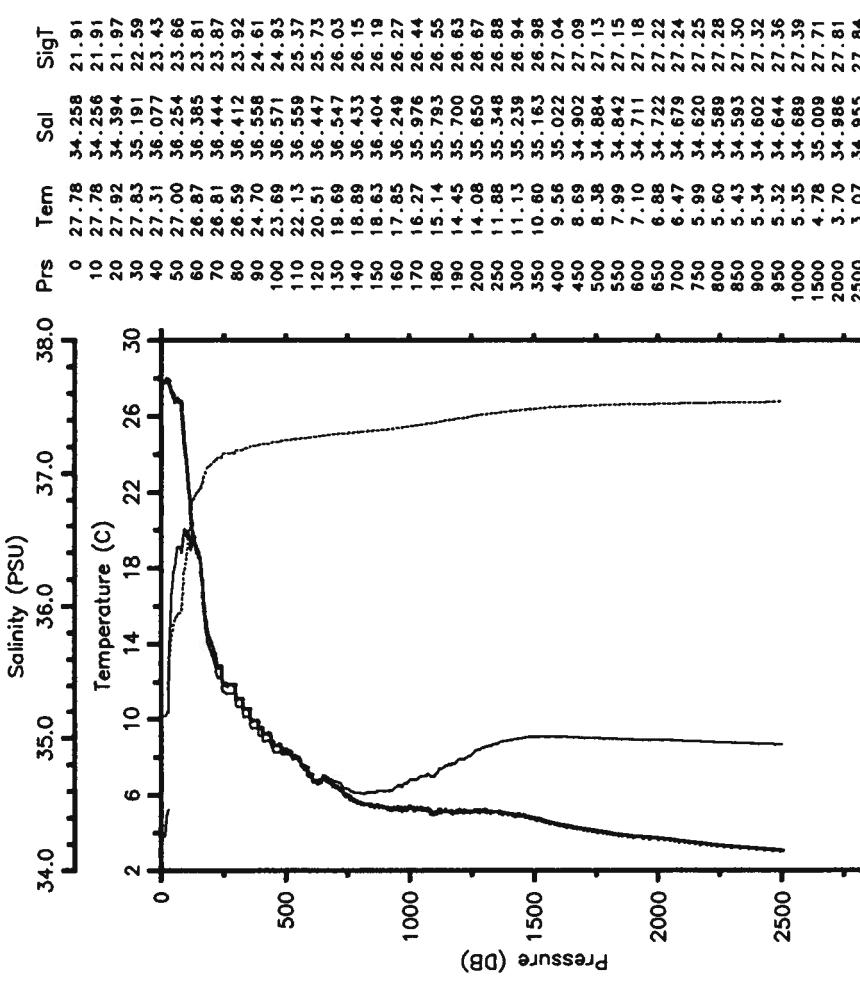


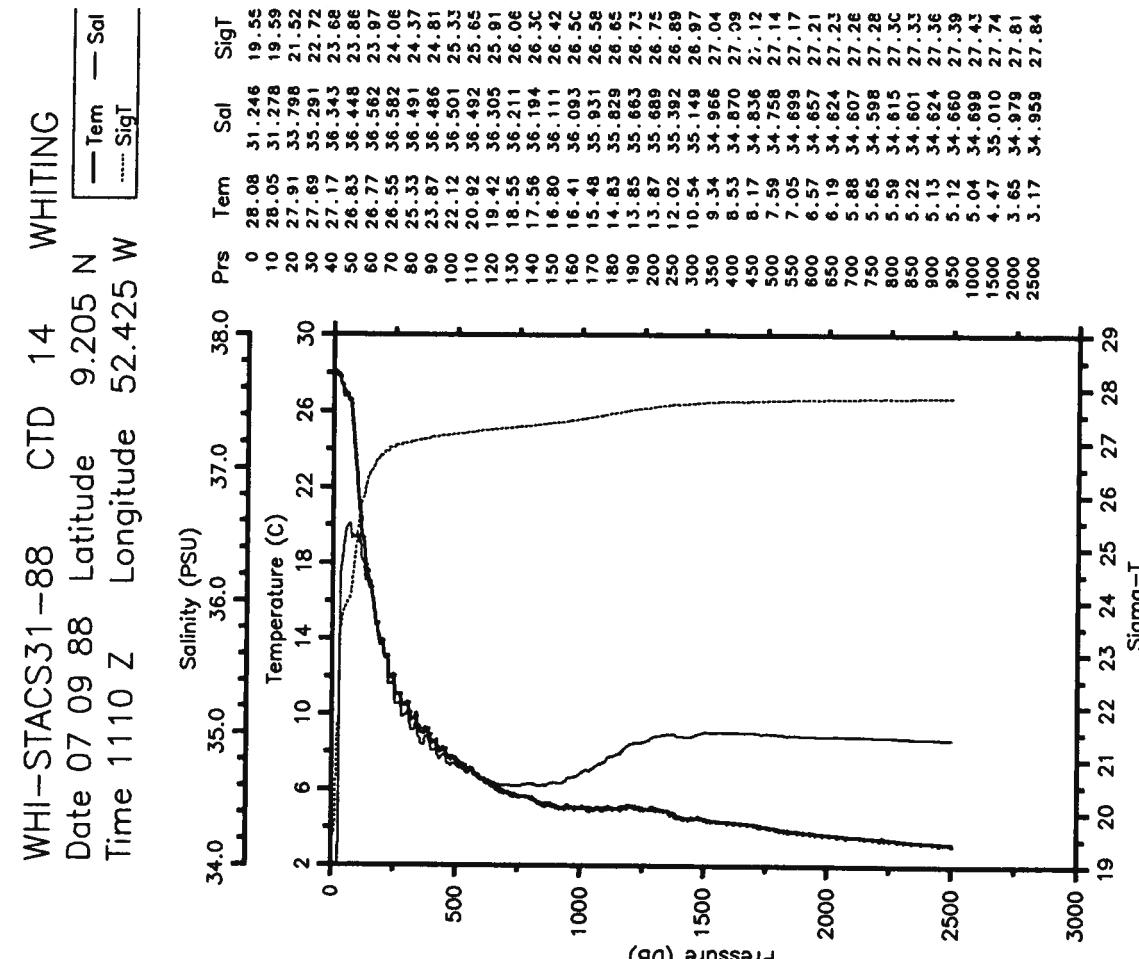
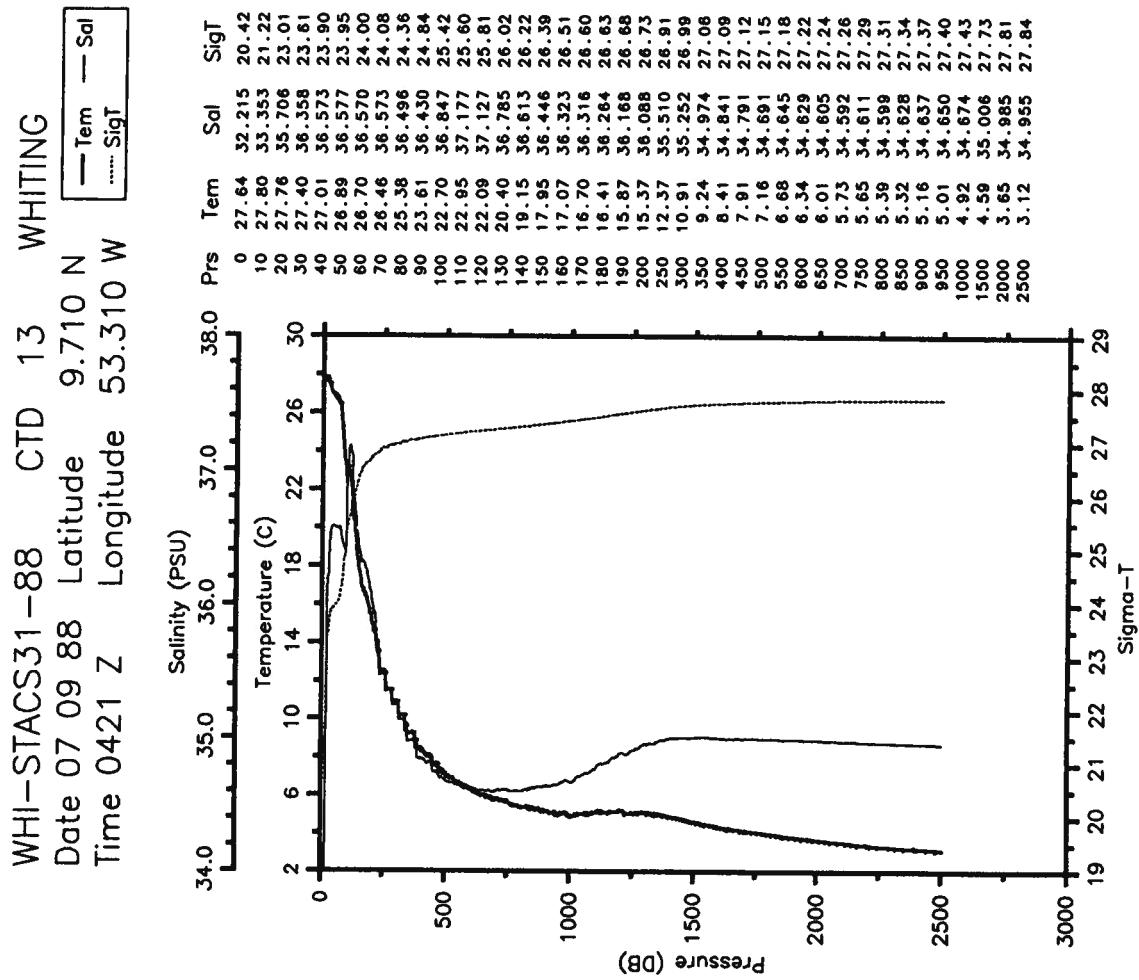


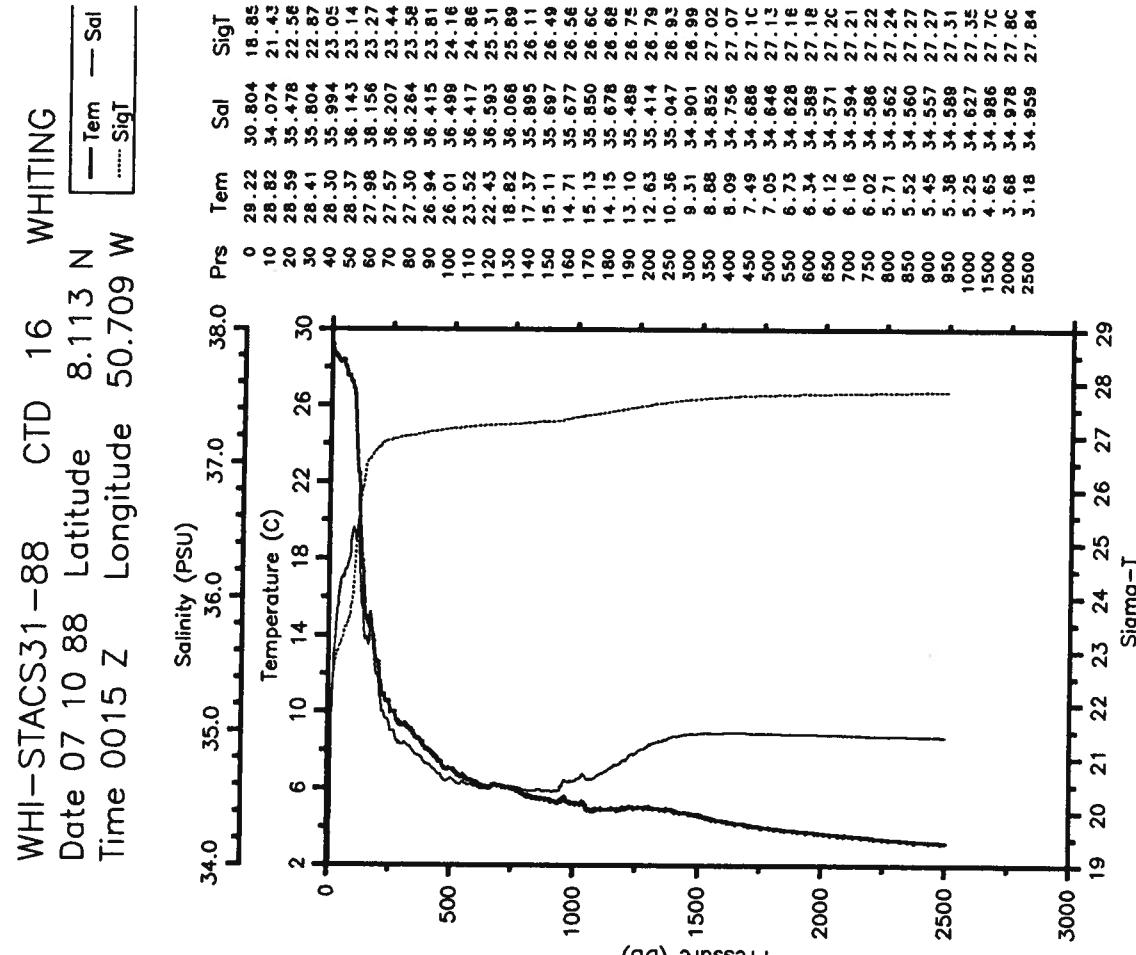
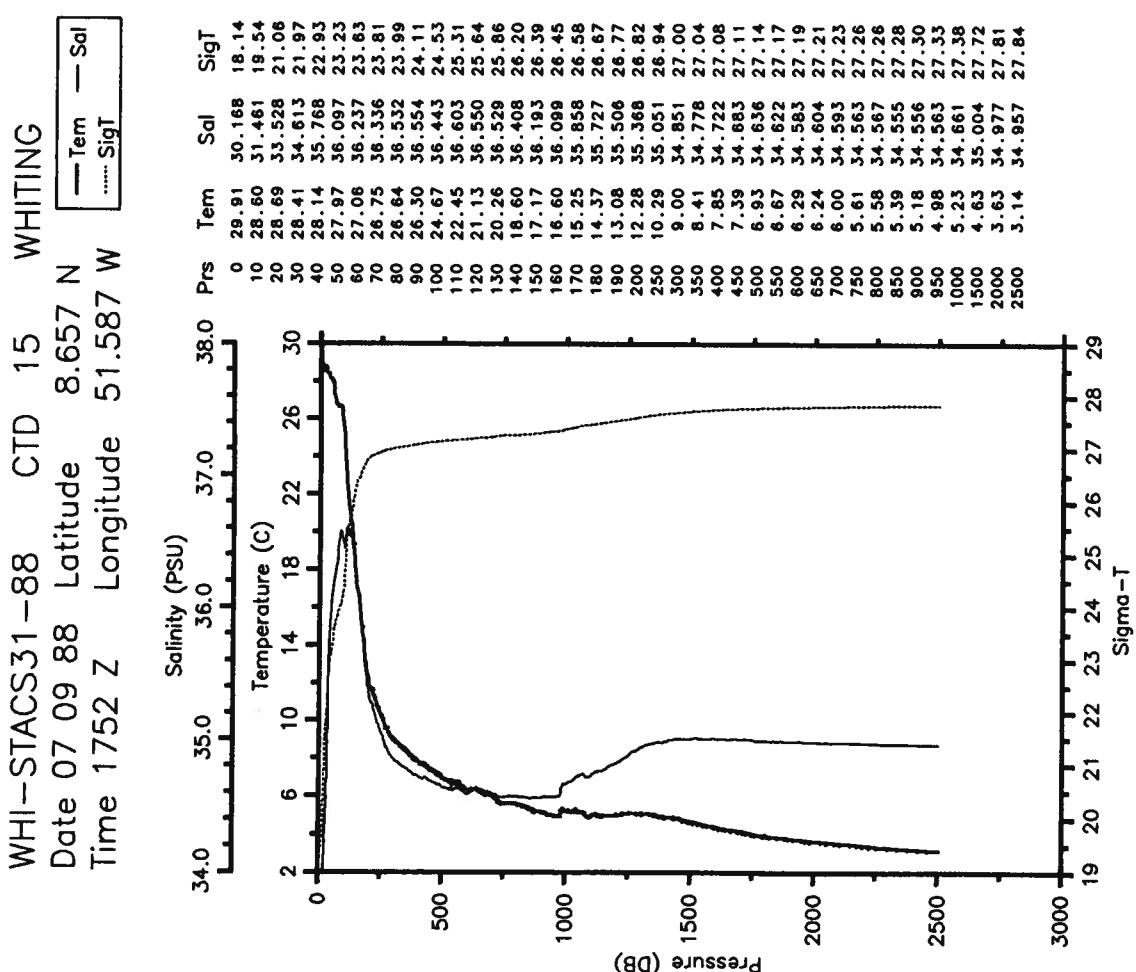


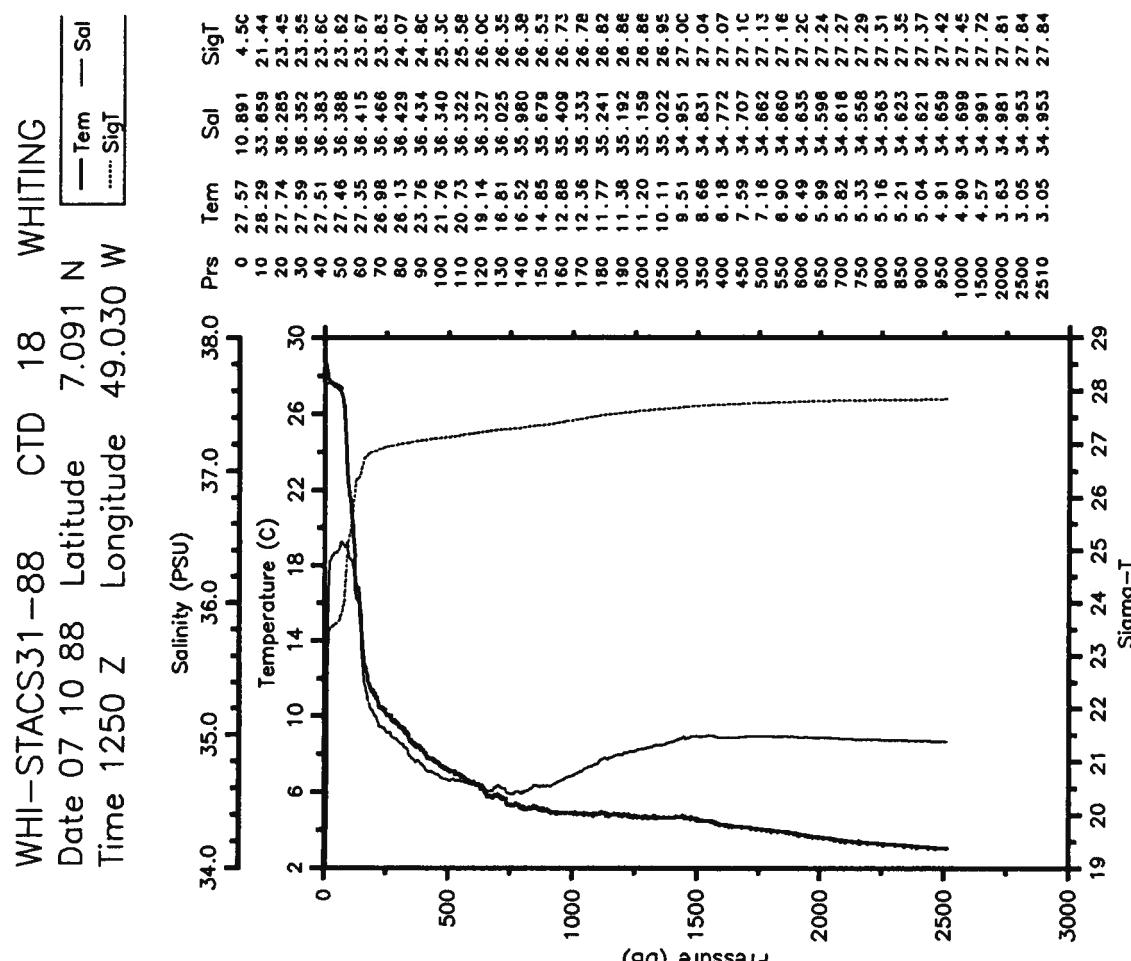
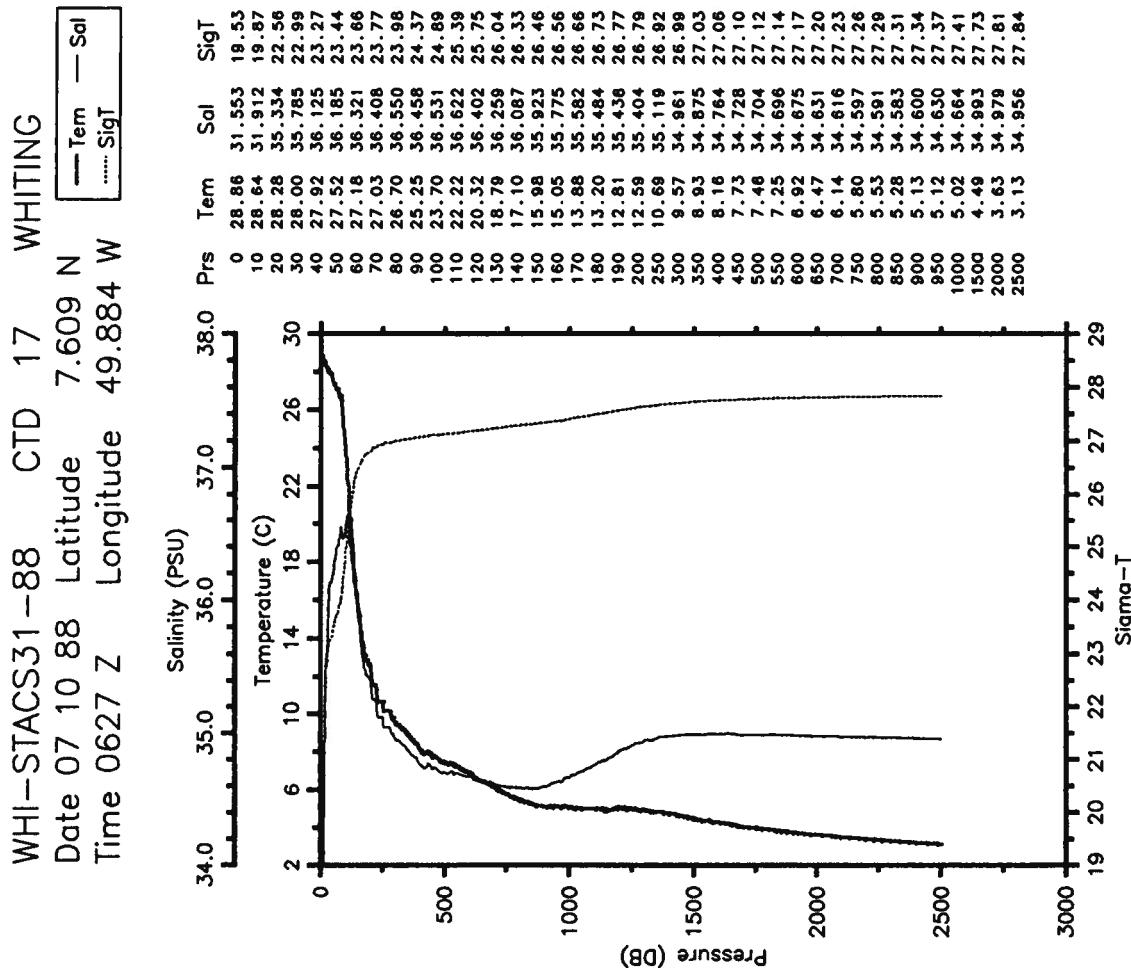
WHI-STACS31-88 CTD 11 WHITING  
 Date 07 08 88 Latitude 10.744 N  
 Time 1131 Z Longitude 55.066 W

WHI-STACS31-88 CTD 12 WHITING  
 Date 07 08 88 Latitude 10.218 N  
 Time 2116 Z Longitude 54.174 W



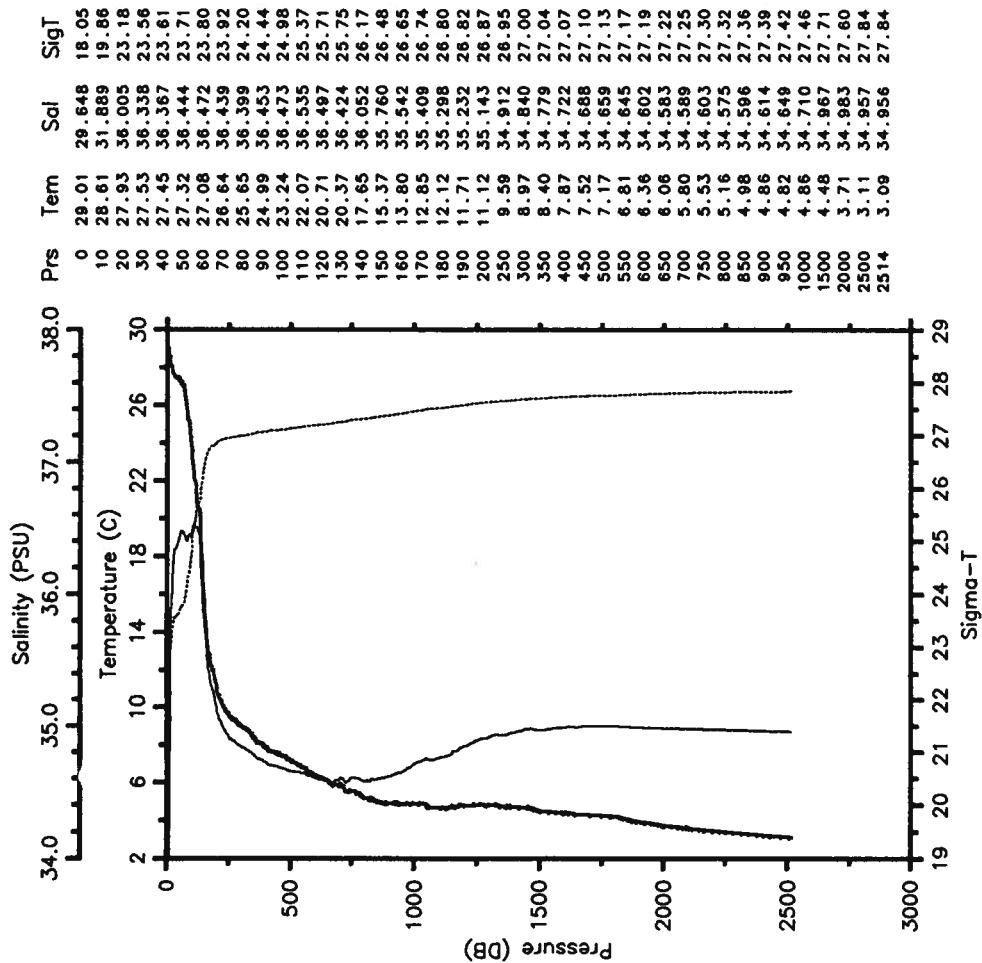






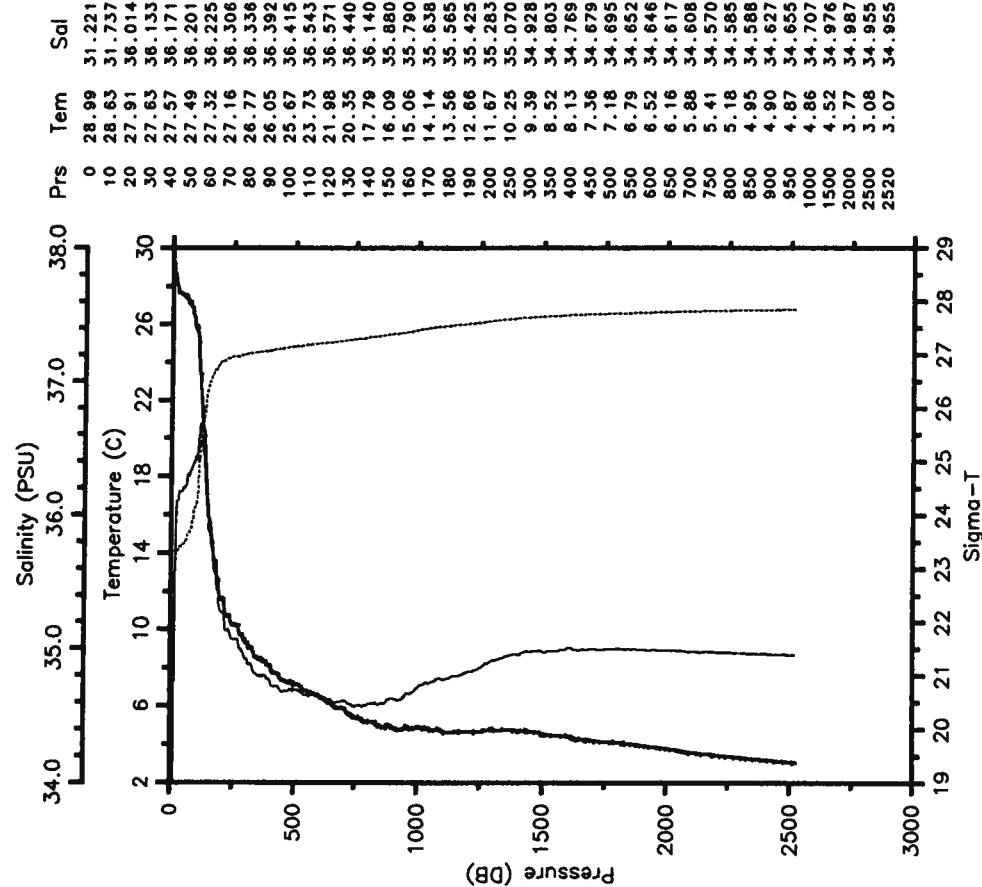
WHI-STACSS31-88 CTD 19 WHITING  
 Date 07 10 88 Latitude 6.672 N  
 Time 1857 Z Longitude 48.274 W

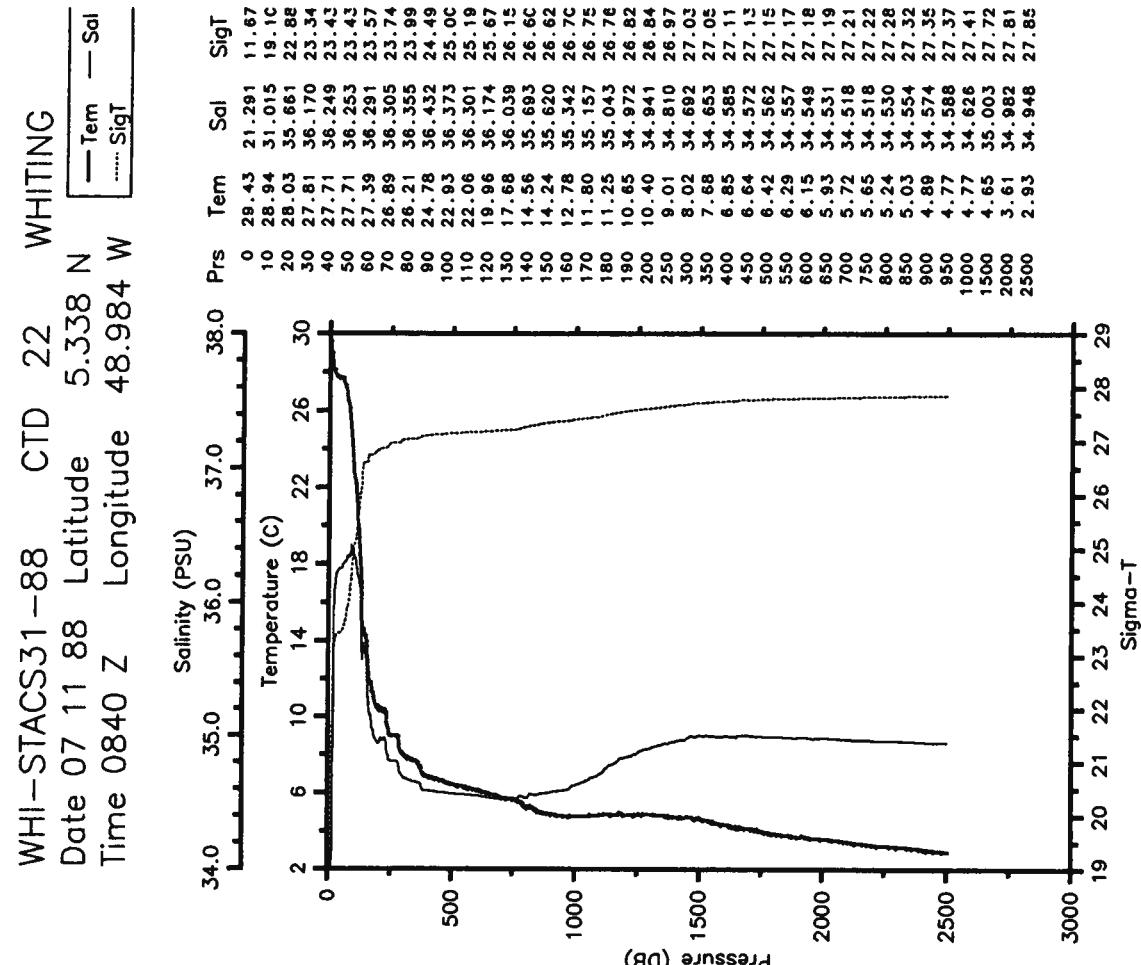
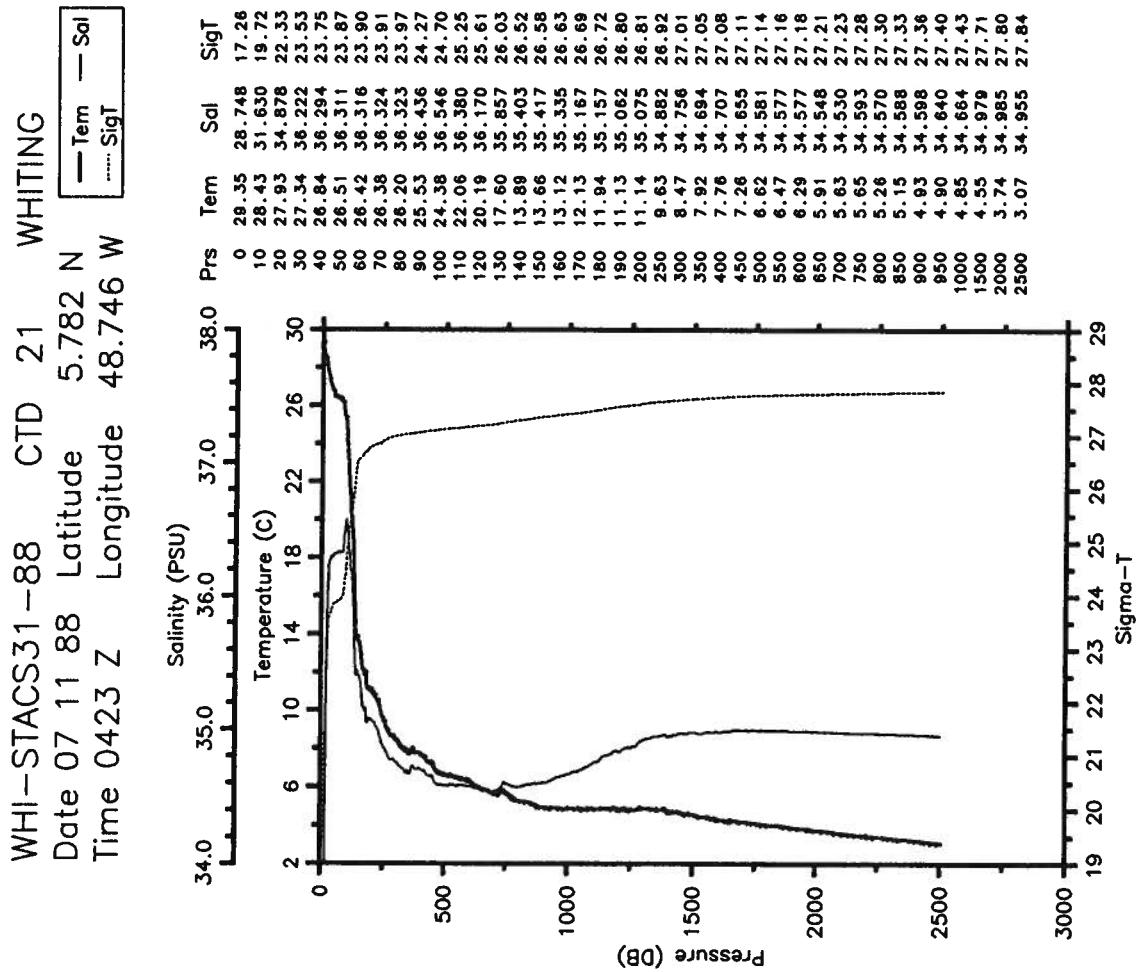
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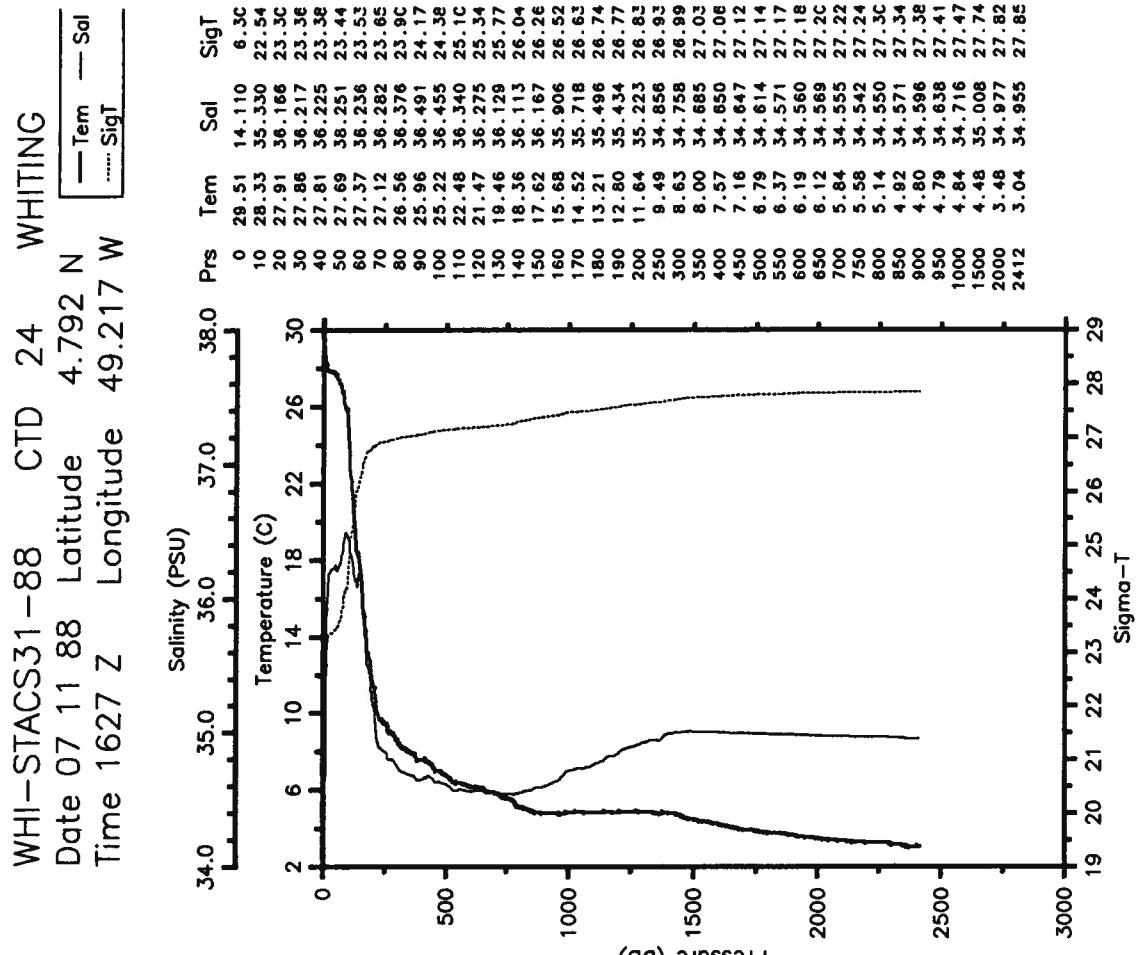
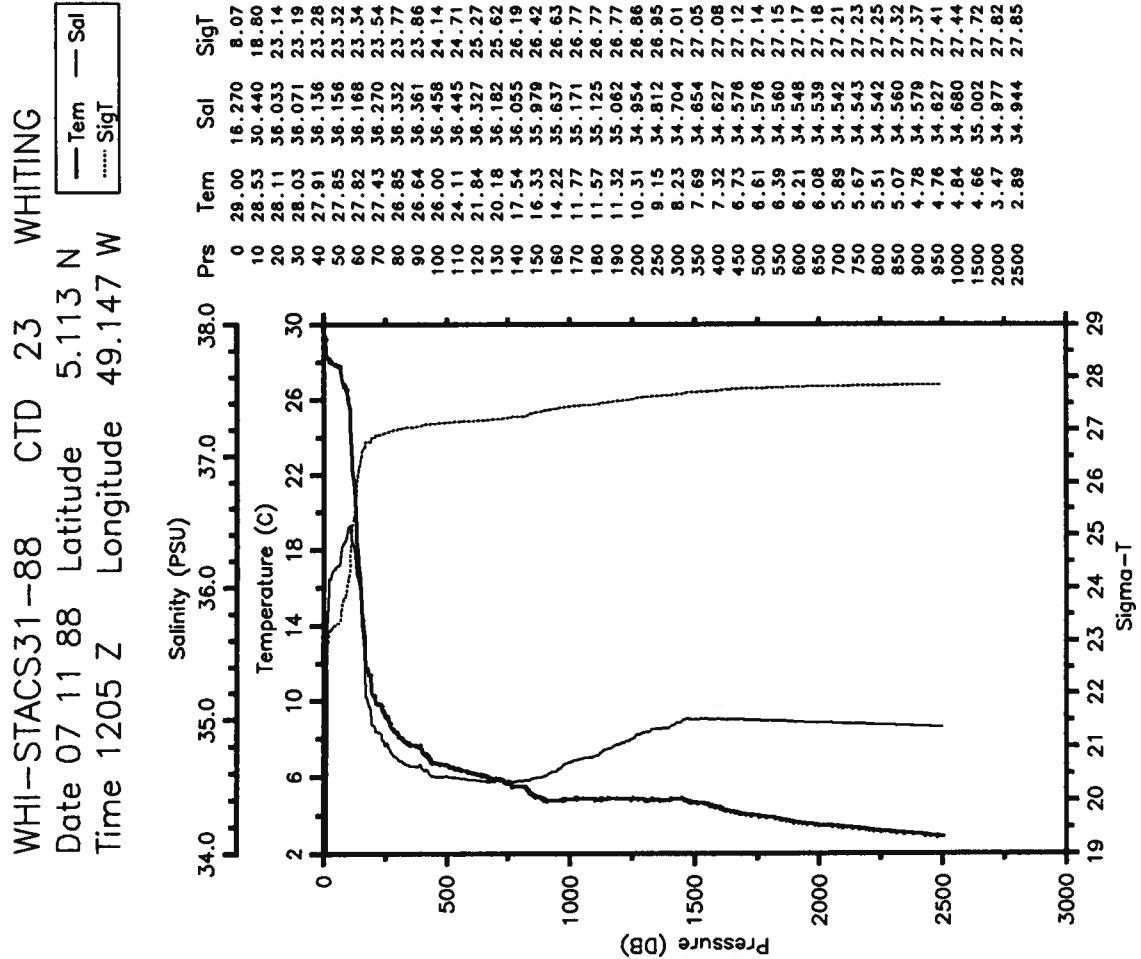


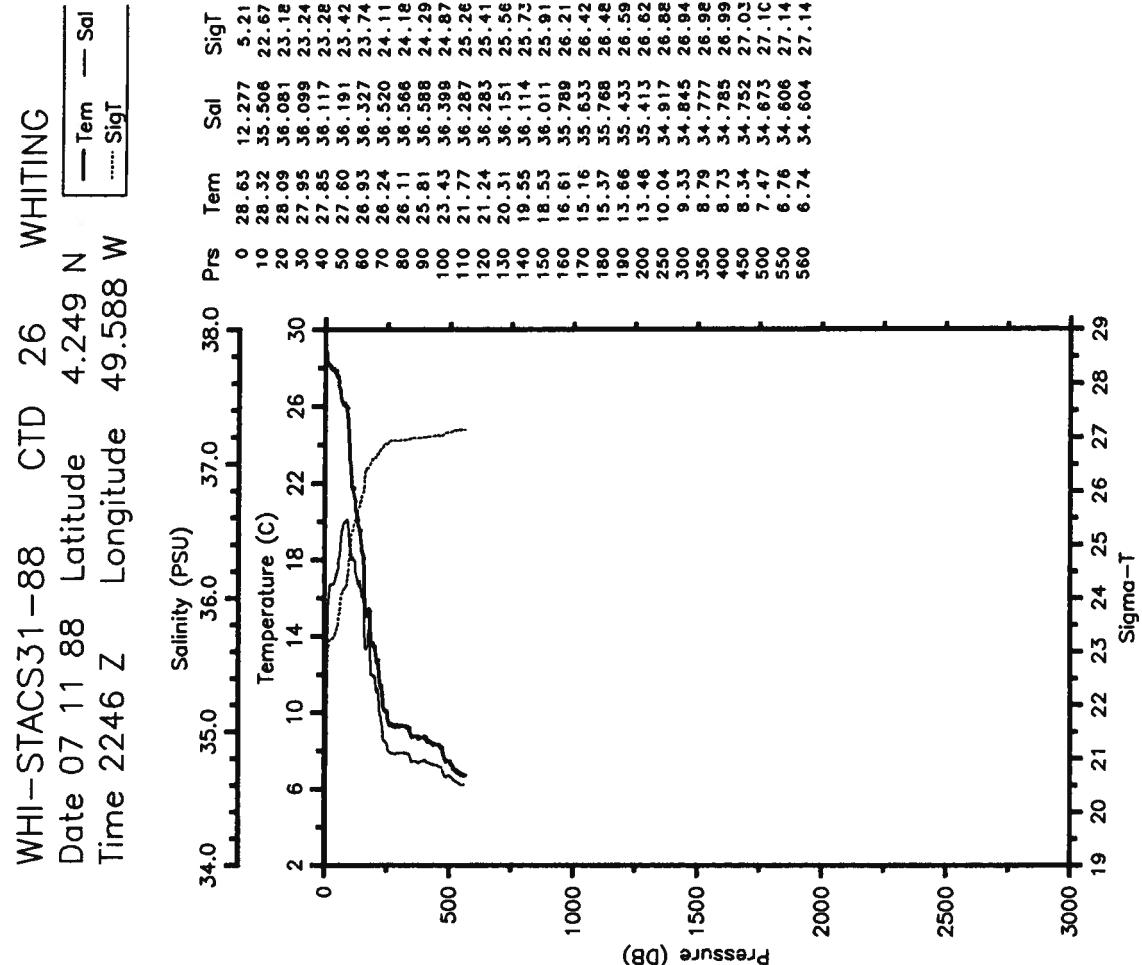
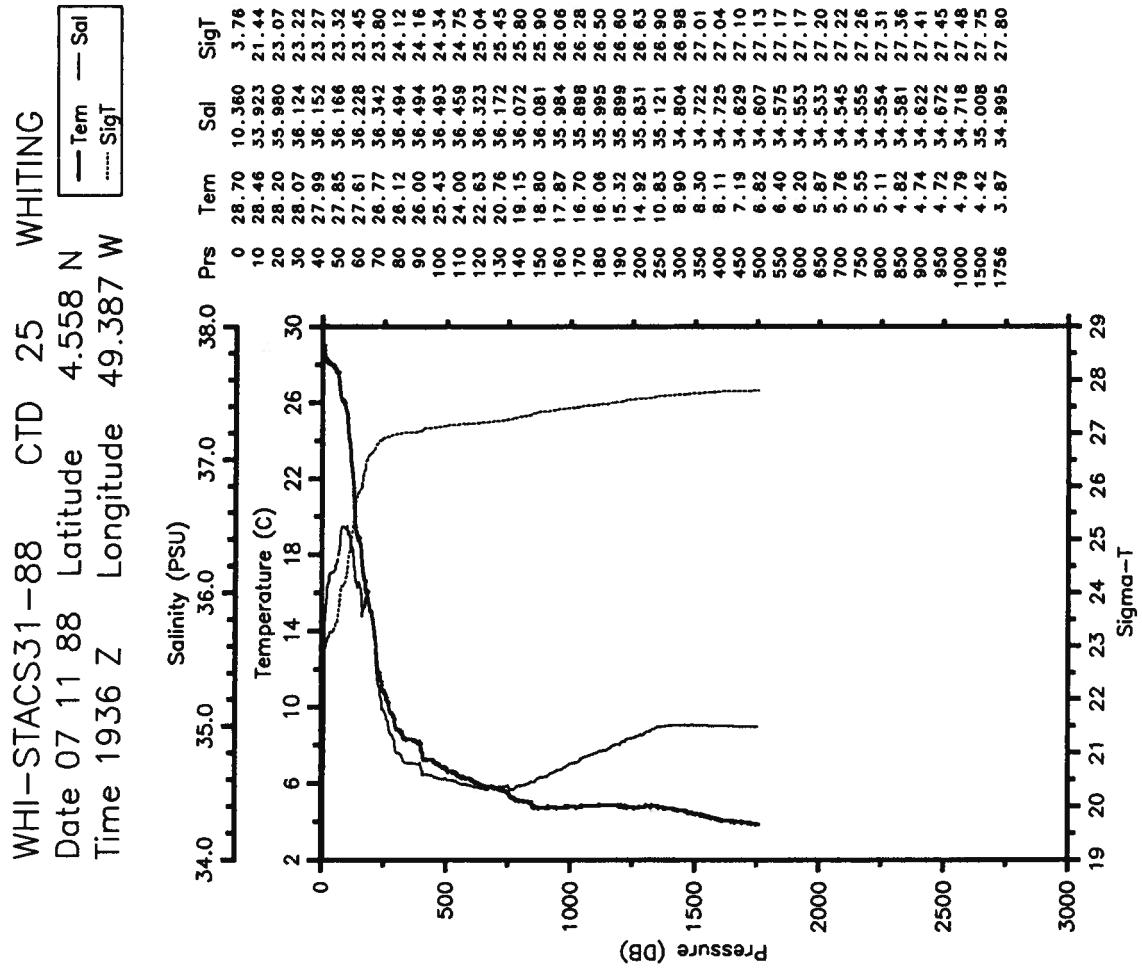
WHI-STACCS31-88 CTD 20 WHITING  
 Date 07 10 88 Latitude 6.219 N  
 Time 2343 Z Longitude 48.512 W

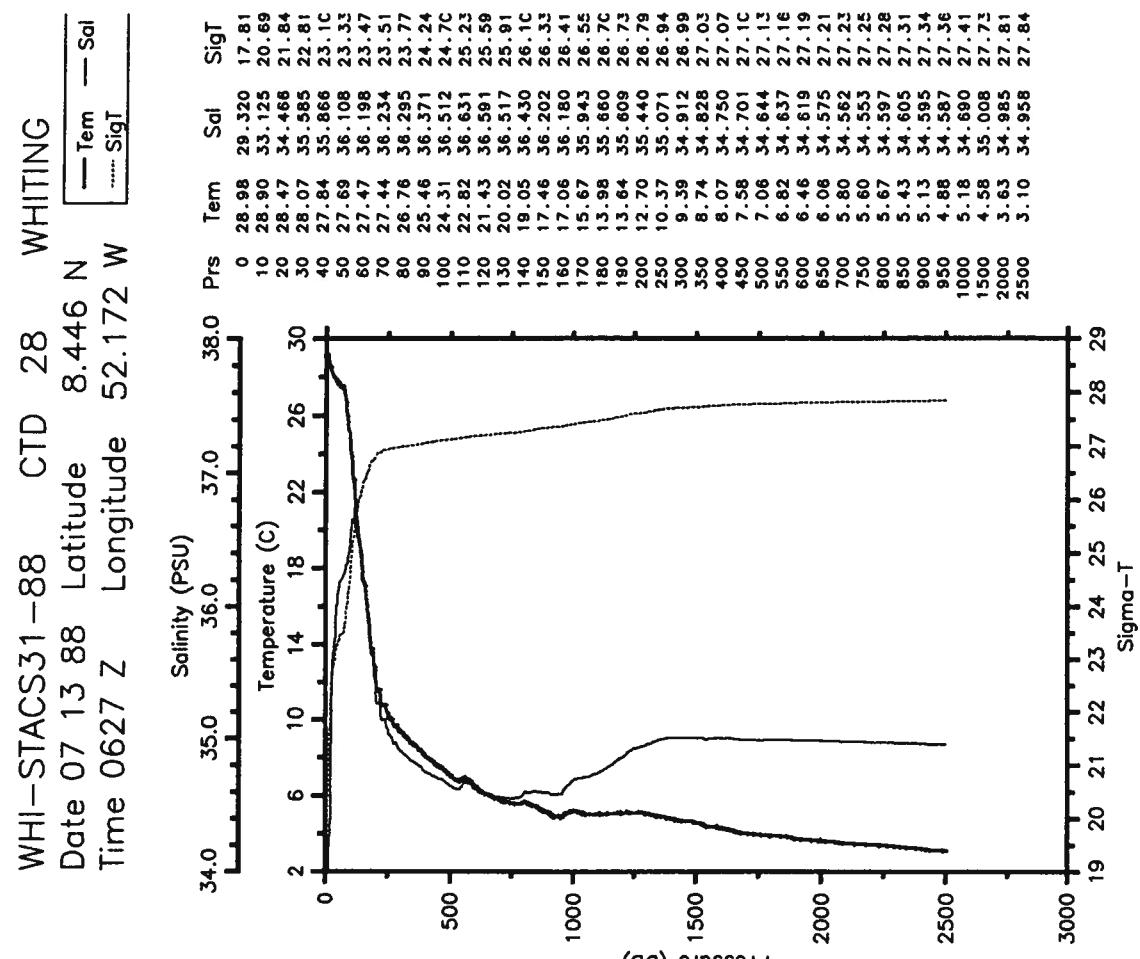
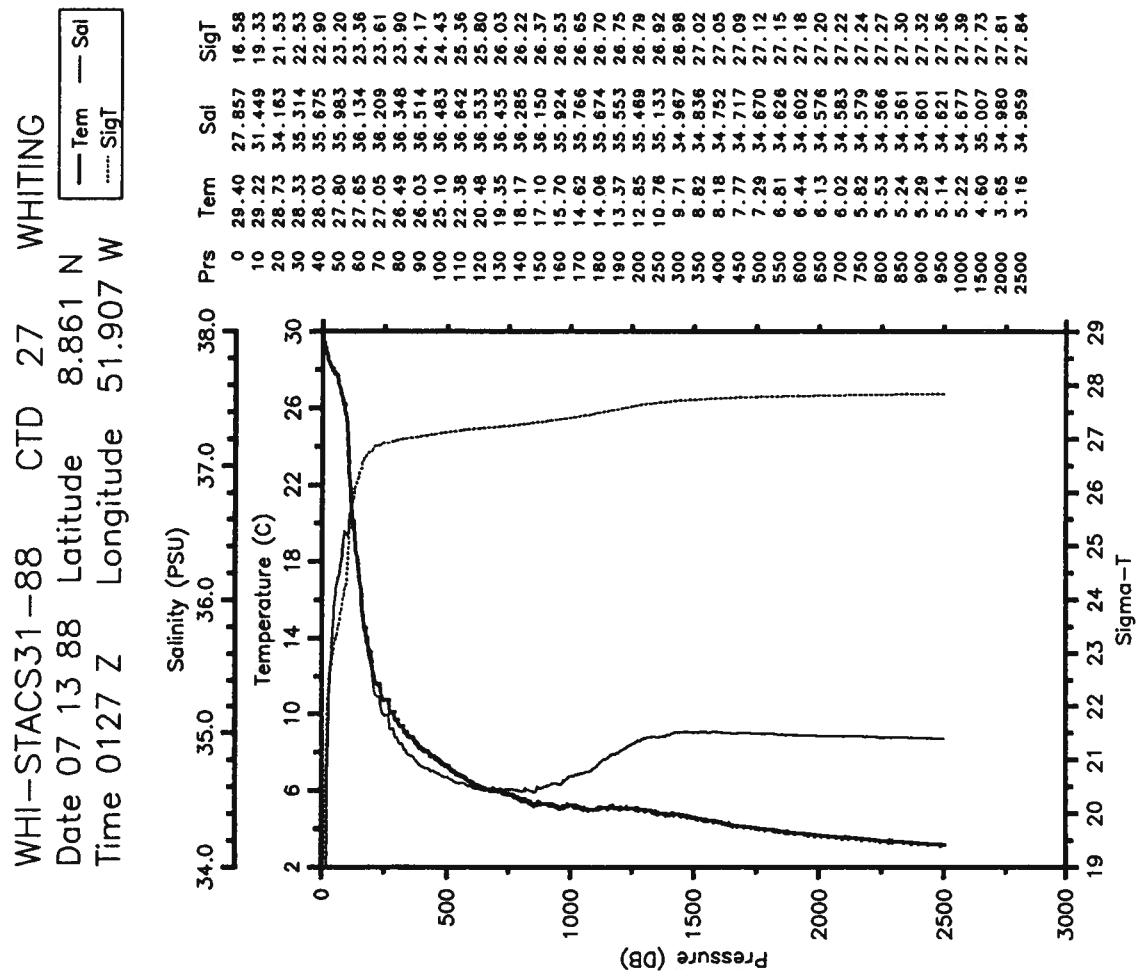
— Tem — Sal  
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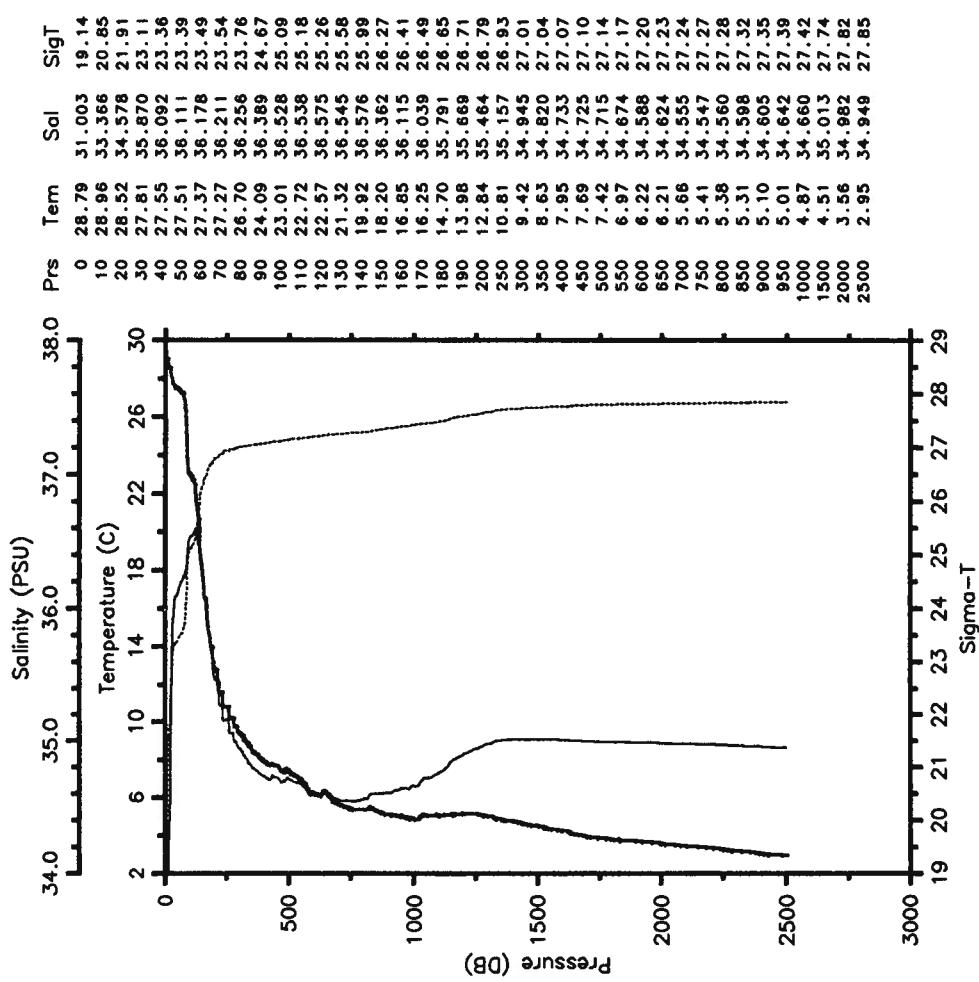




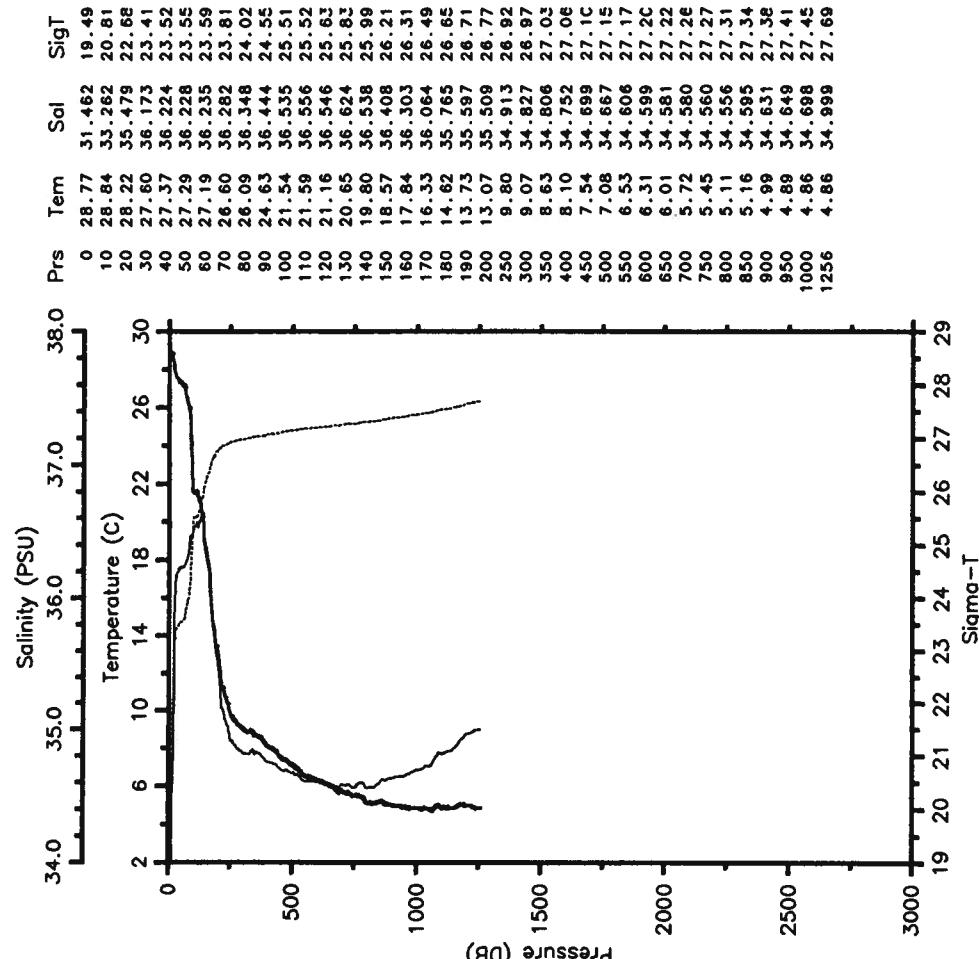


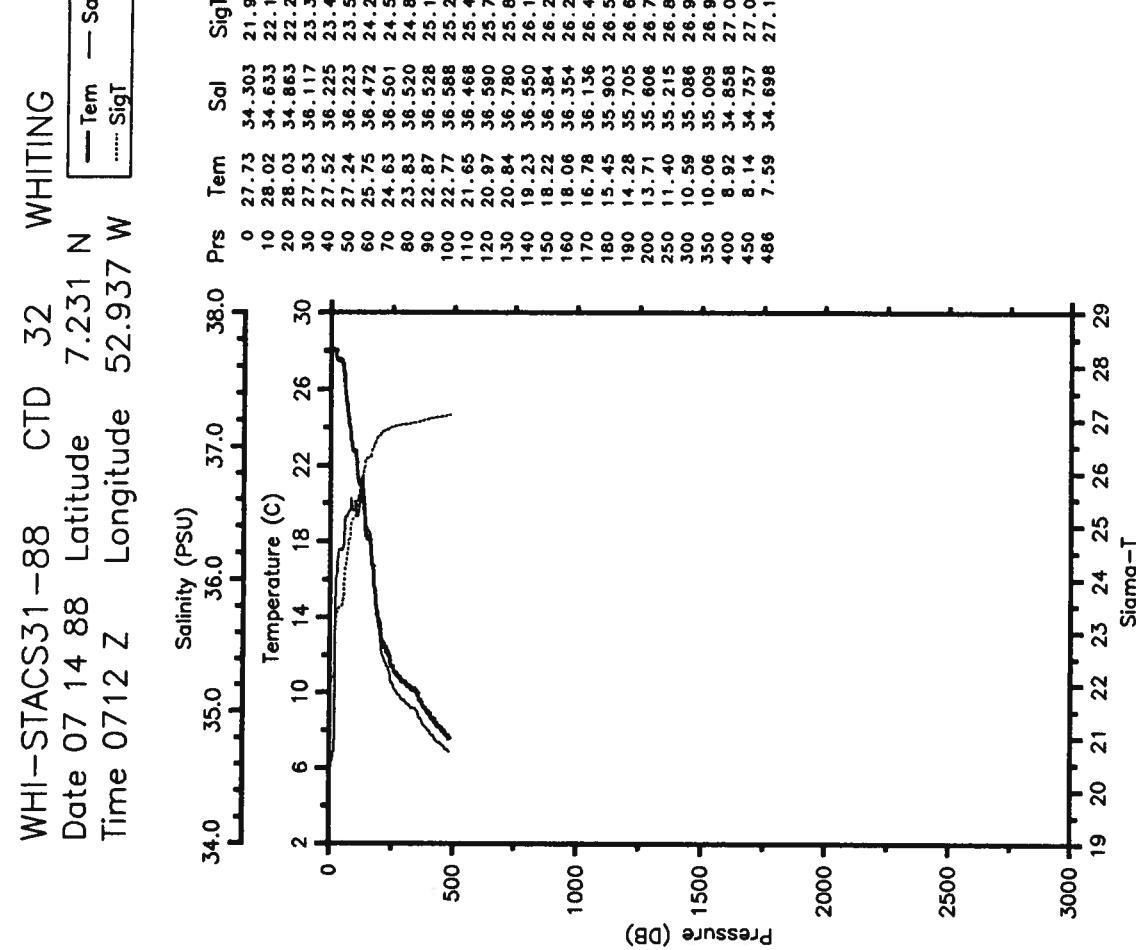
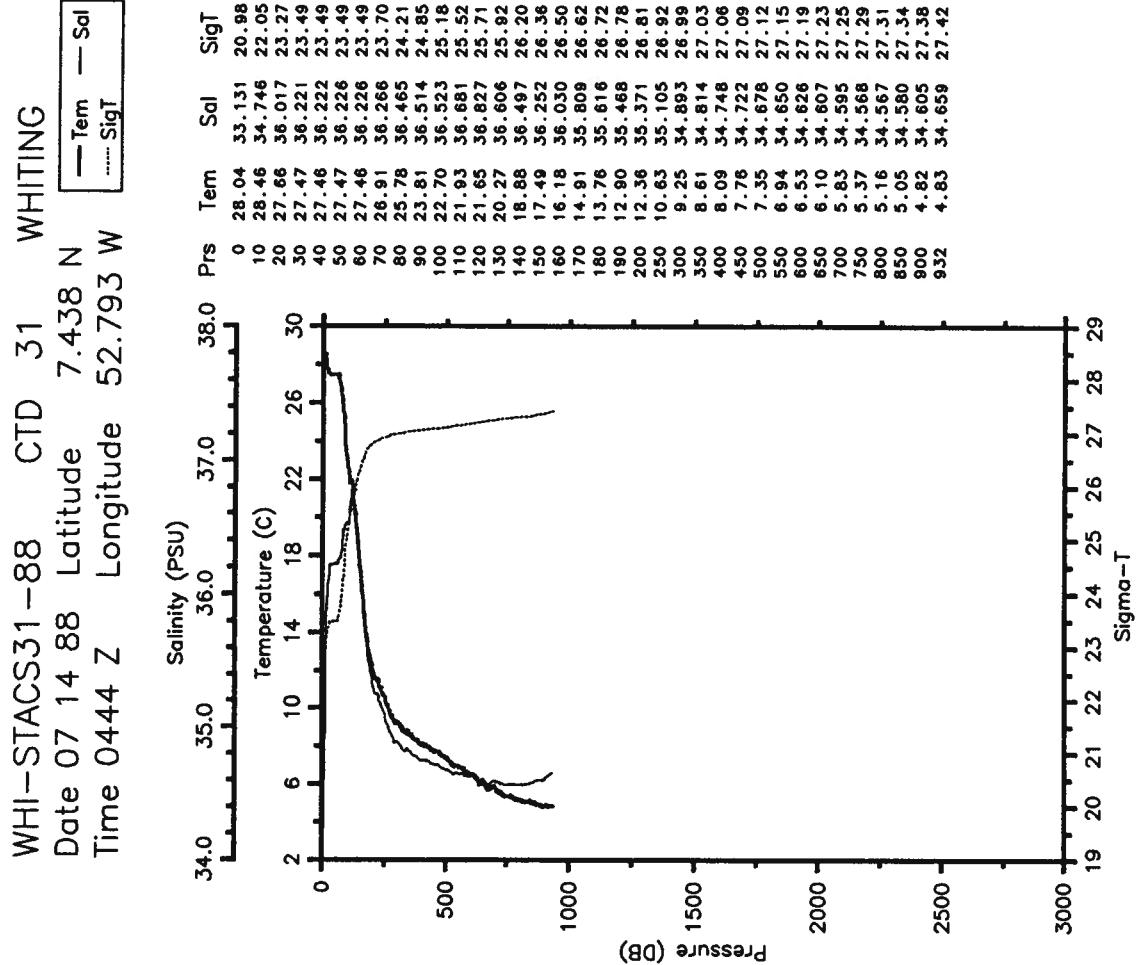


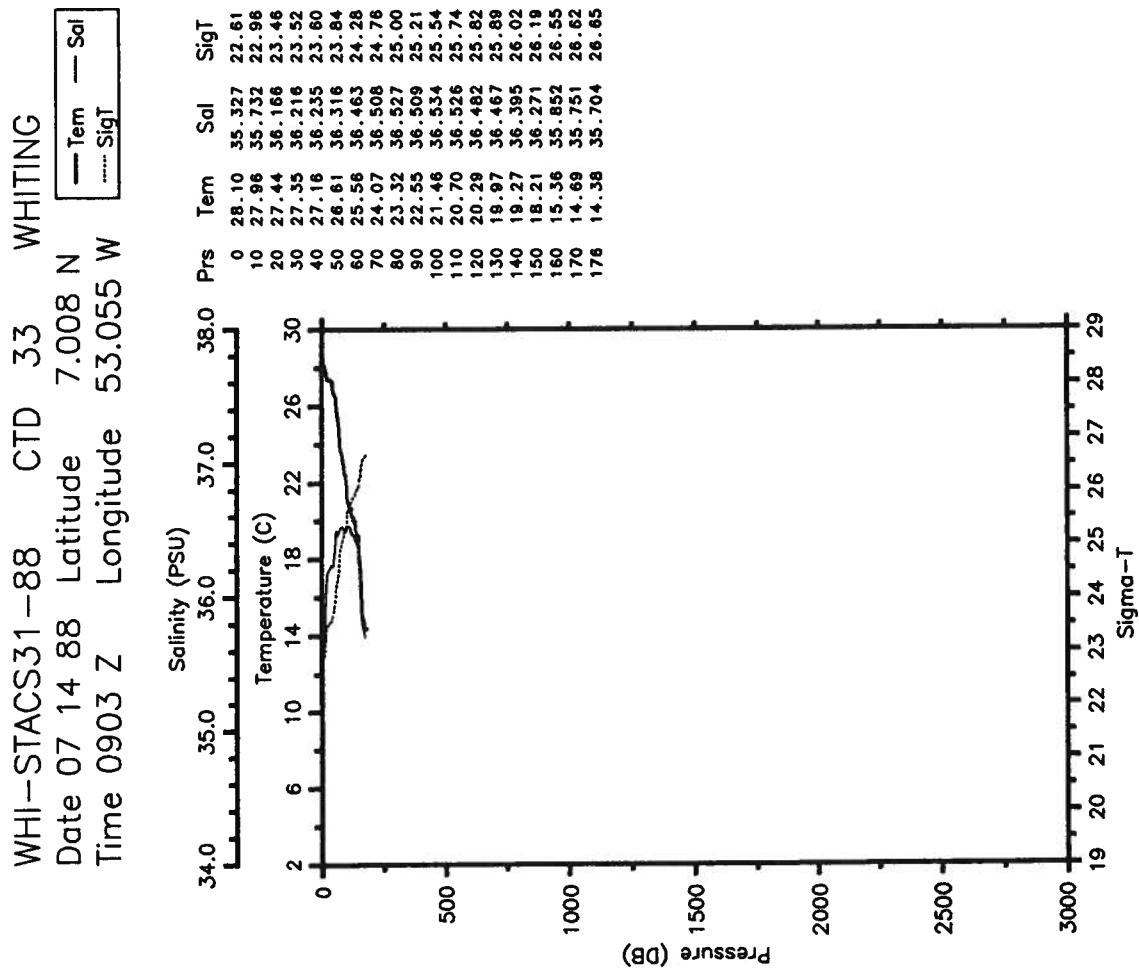
WHI-STACCS31-88      CTD    29      WHITING  
 Date 07 13 88      Latitude 8.032 N  
 Time 1130 Z      Longitude 52.436 W



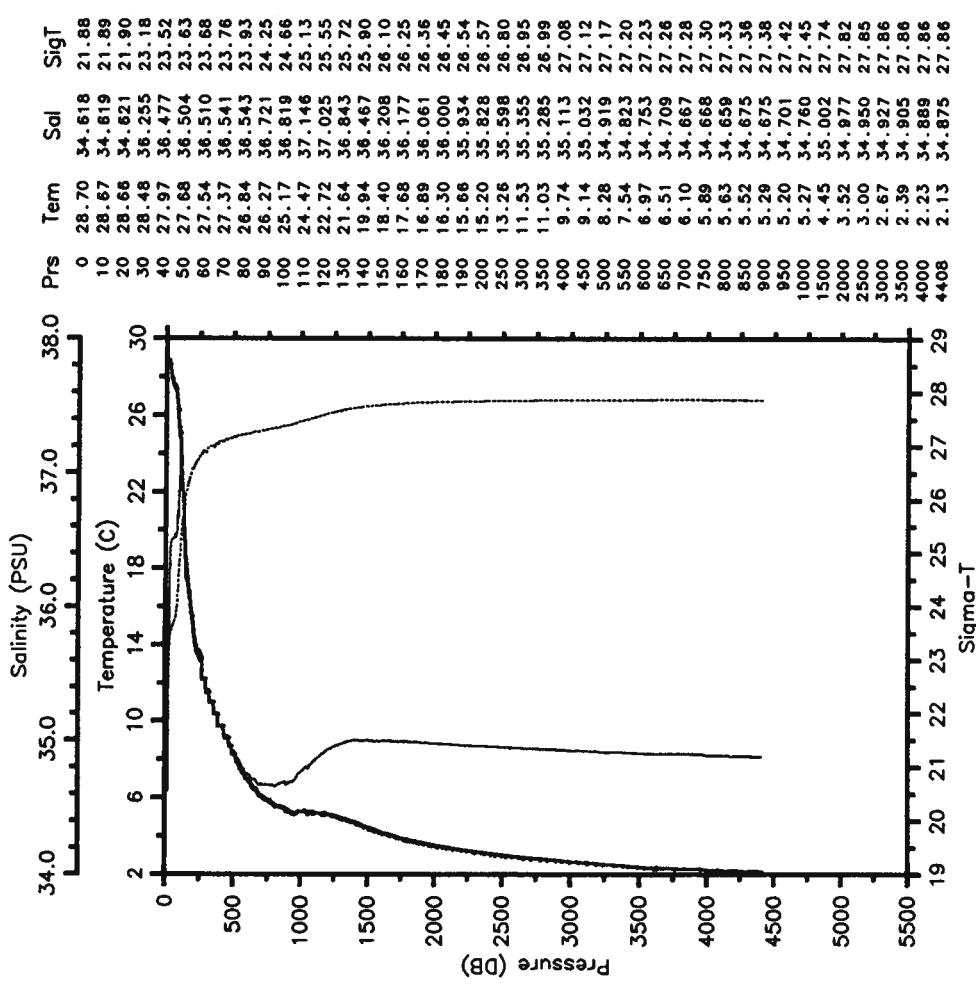
WHI-STACCS31-88      CTD    30      WHITING  
 Date 07 14 88      Latitude 7.662 N  
 Time 0136 Z      Longitude 52.666 W



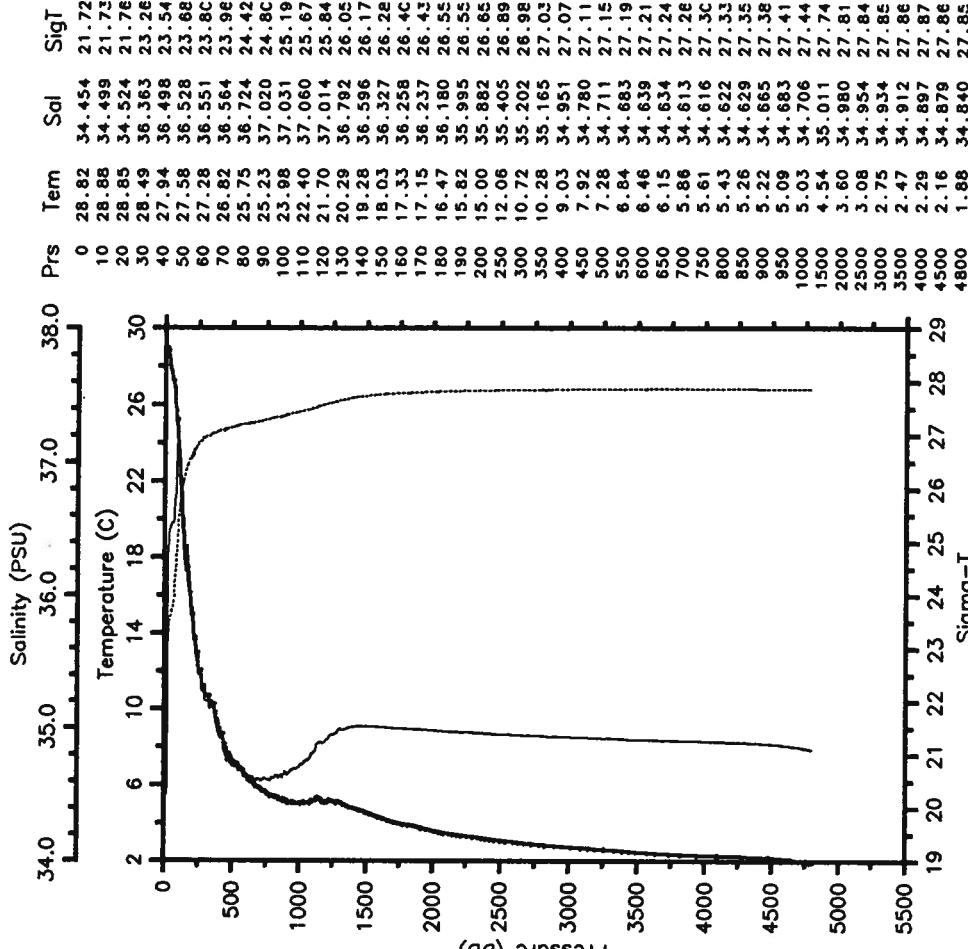


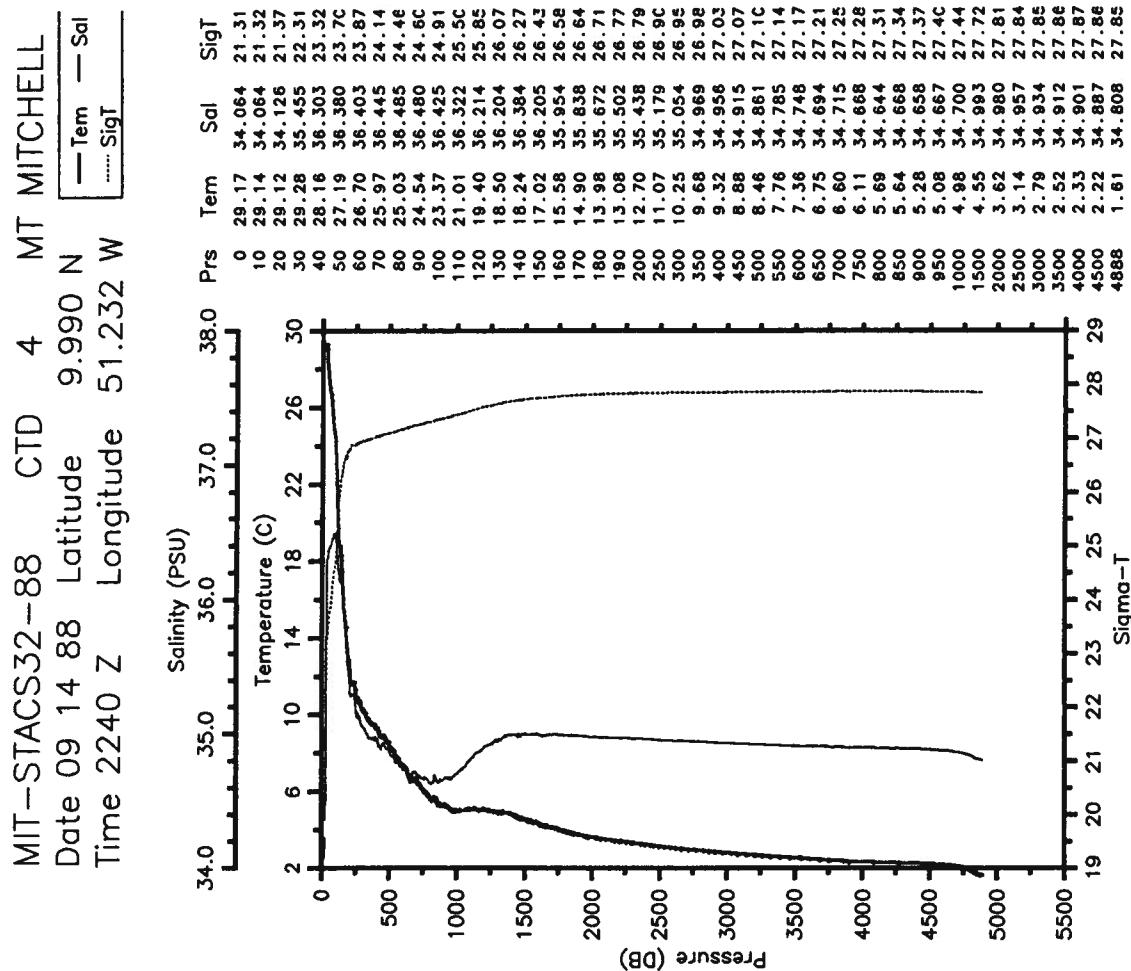
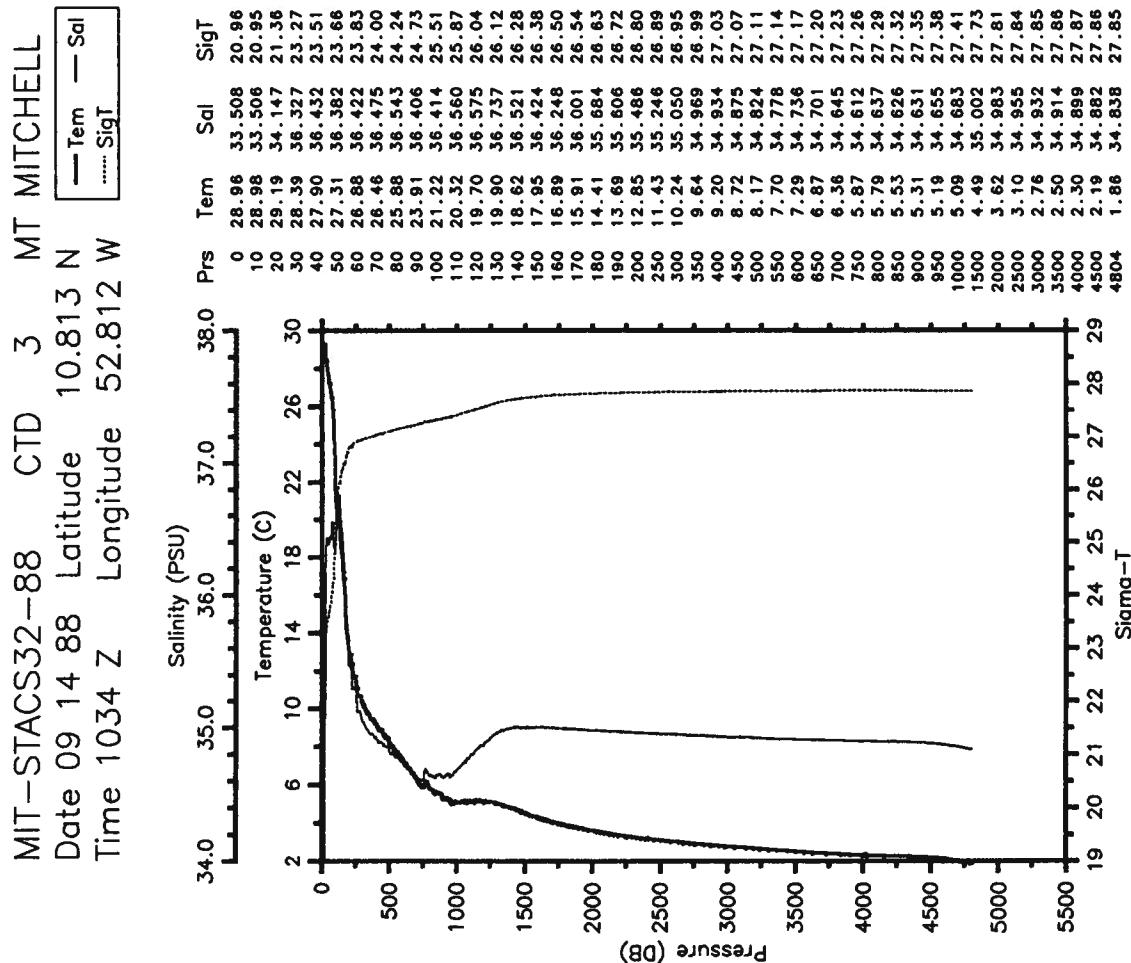


MIT-STACCS32-88 CTD 1 MT MITCHELL  
 Date 09 13 88 Latitude 12.200 N  
 Time 1254 Z Longitude 55.447 W



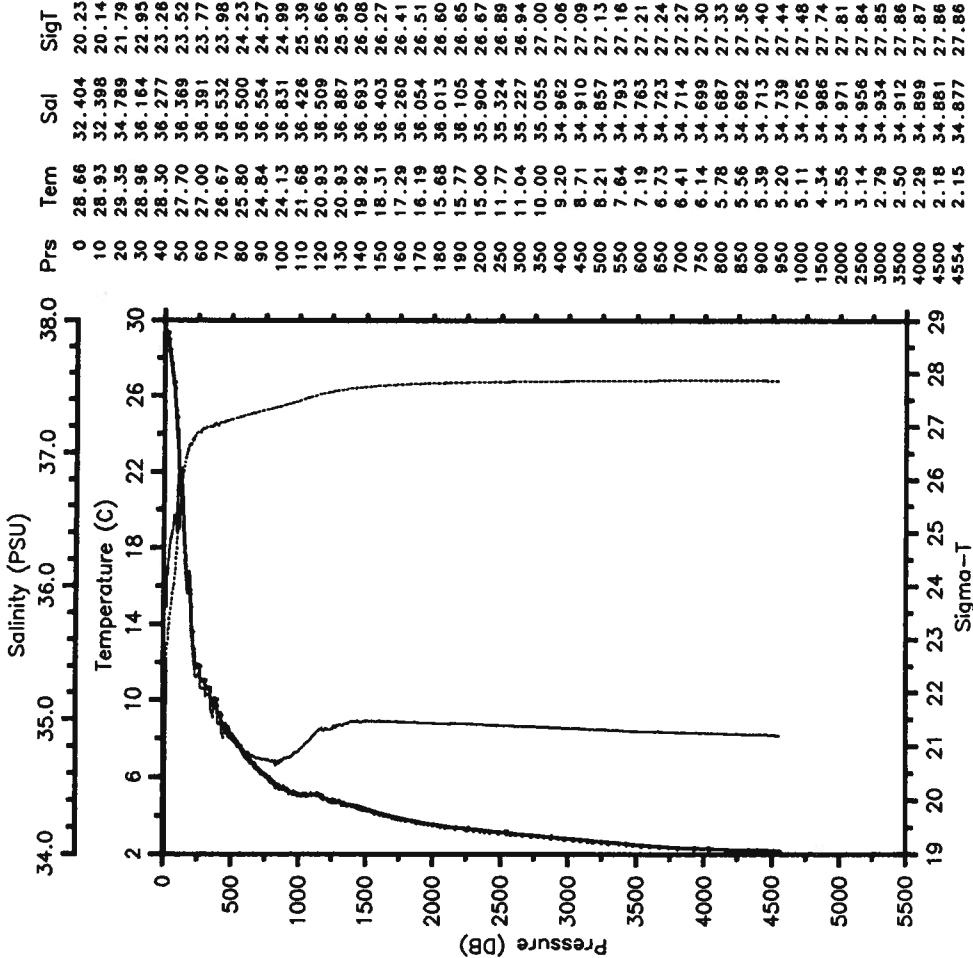
MIT-STACCS32-88 CTD 2 MT MITCHELL  
 Date 09 13 88 Latitude 11.547 N  
 Time 2235 Z Longitude 54.270 W





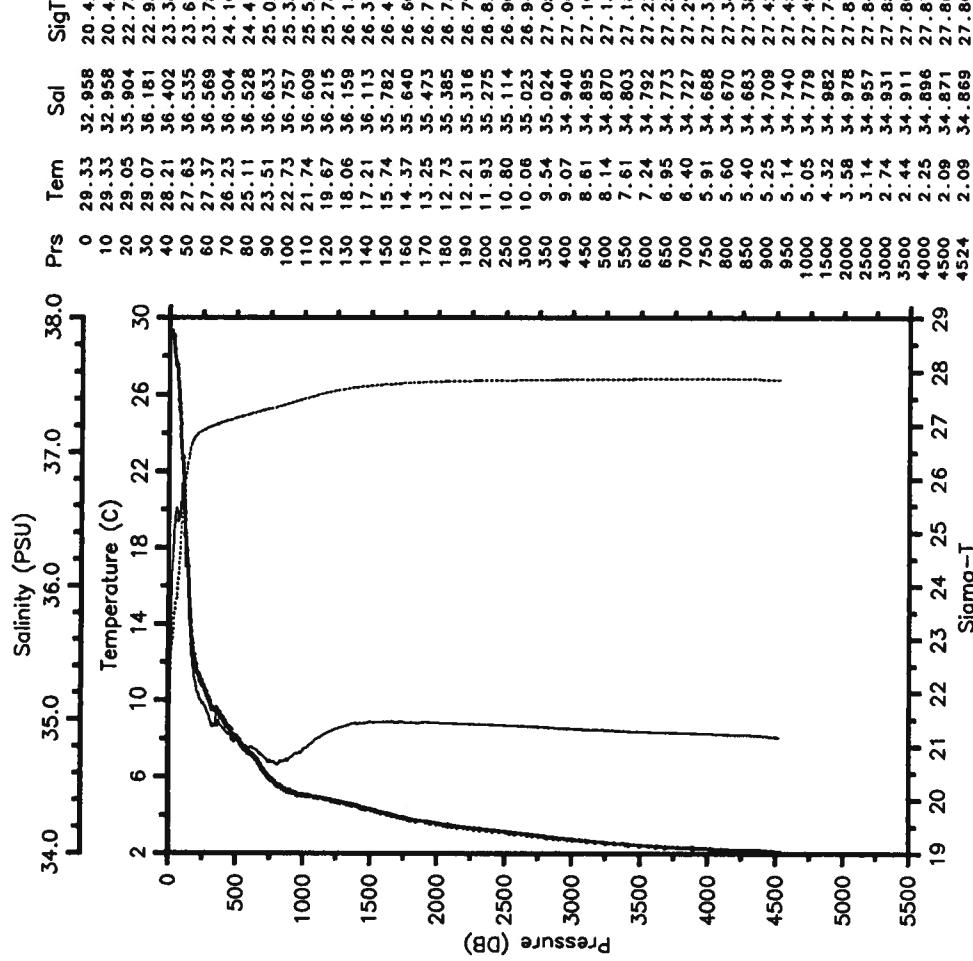
MIT-STACSS32-88 CTD 5 MT MITCHELL  
 Date 09 15 88 Latitude 9.263 N  
 Time 0807 Z Longitude 49.978 W

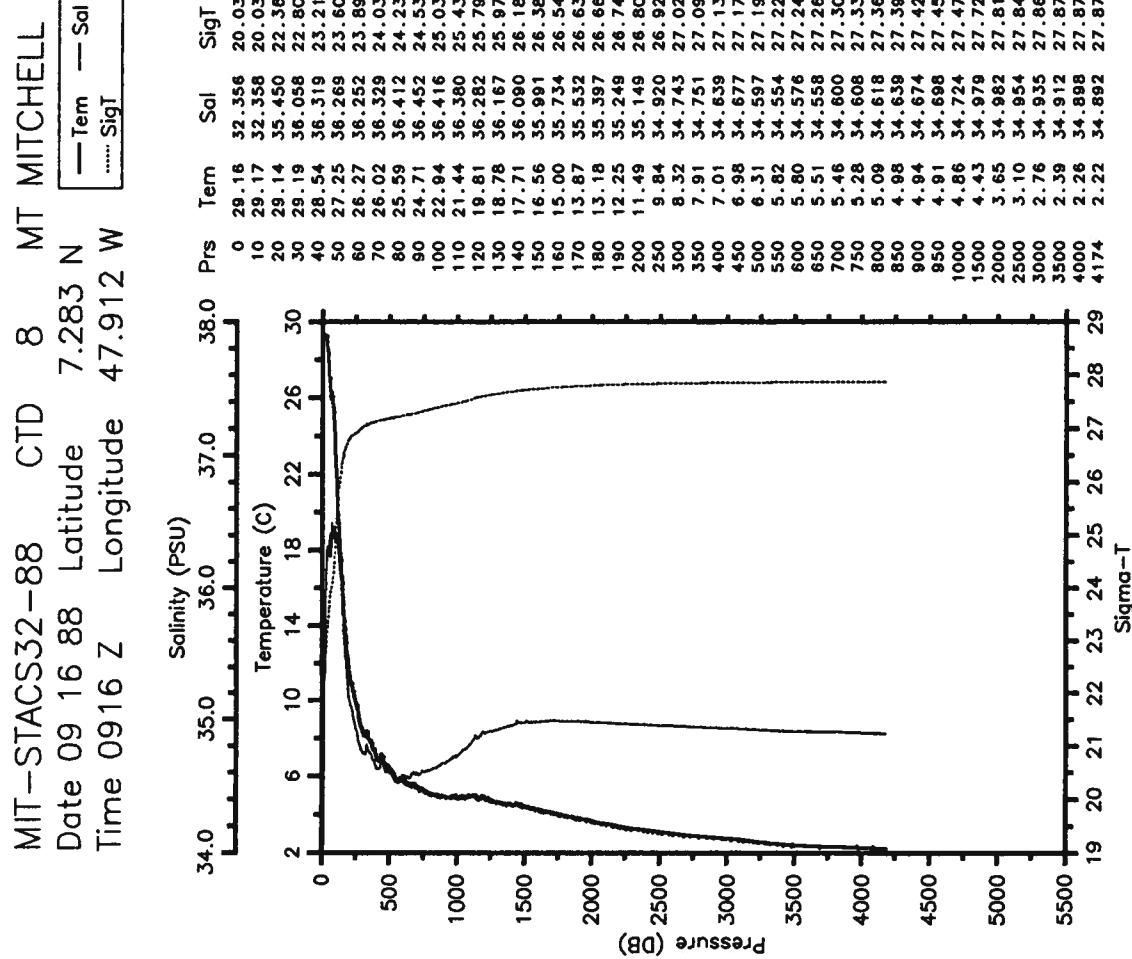
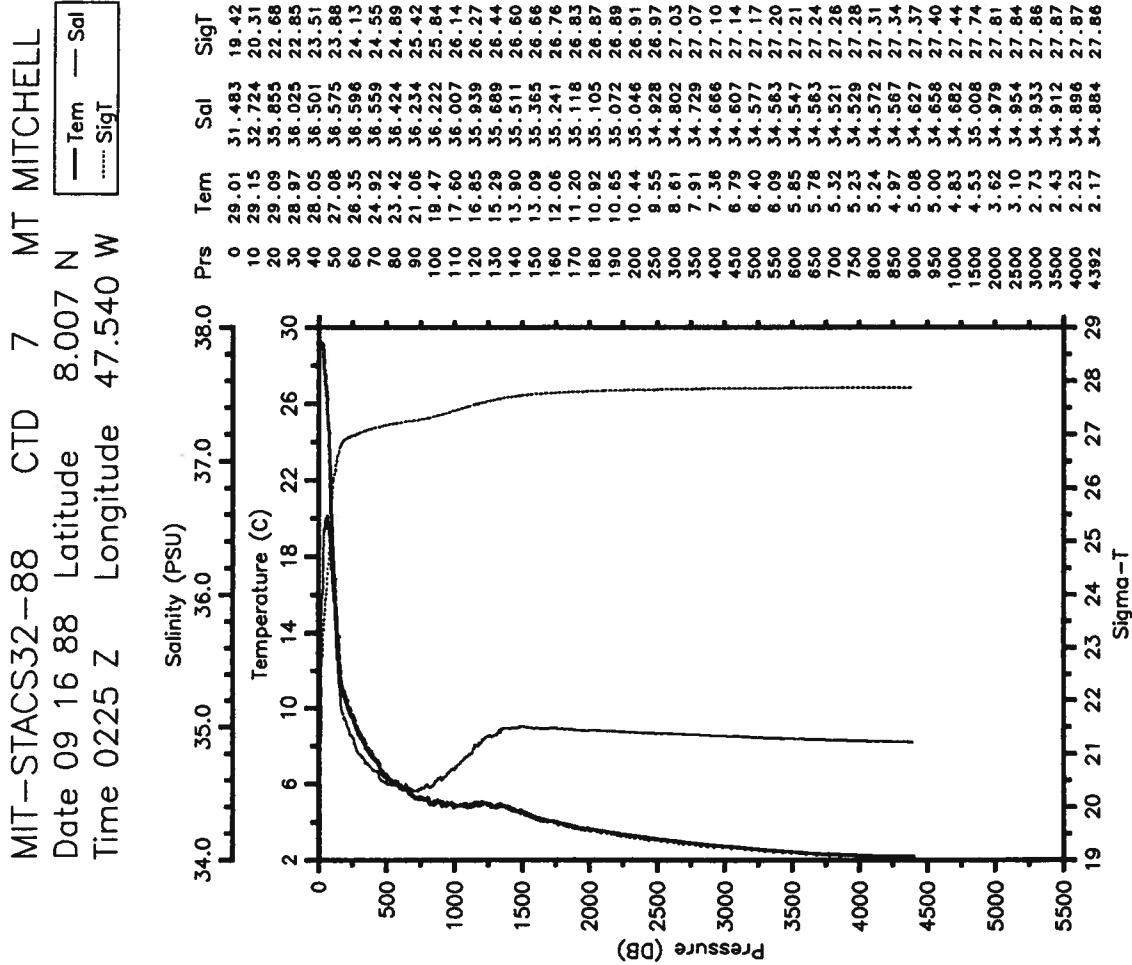
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MIT-STACSS32-88 CTD 6 MT MITCHELL  
 Date 09 15 88 Latitude 8.675 N  
 Time 1642 Z Longitude 48.810 W

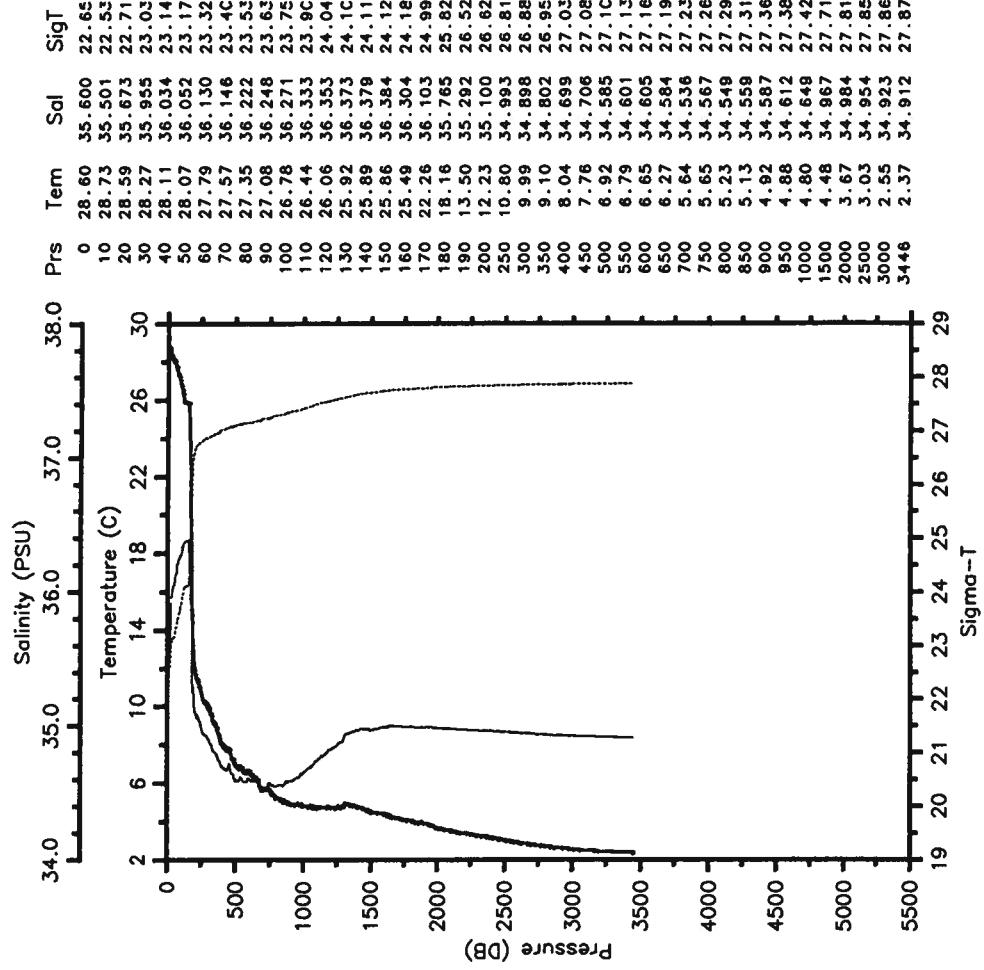
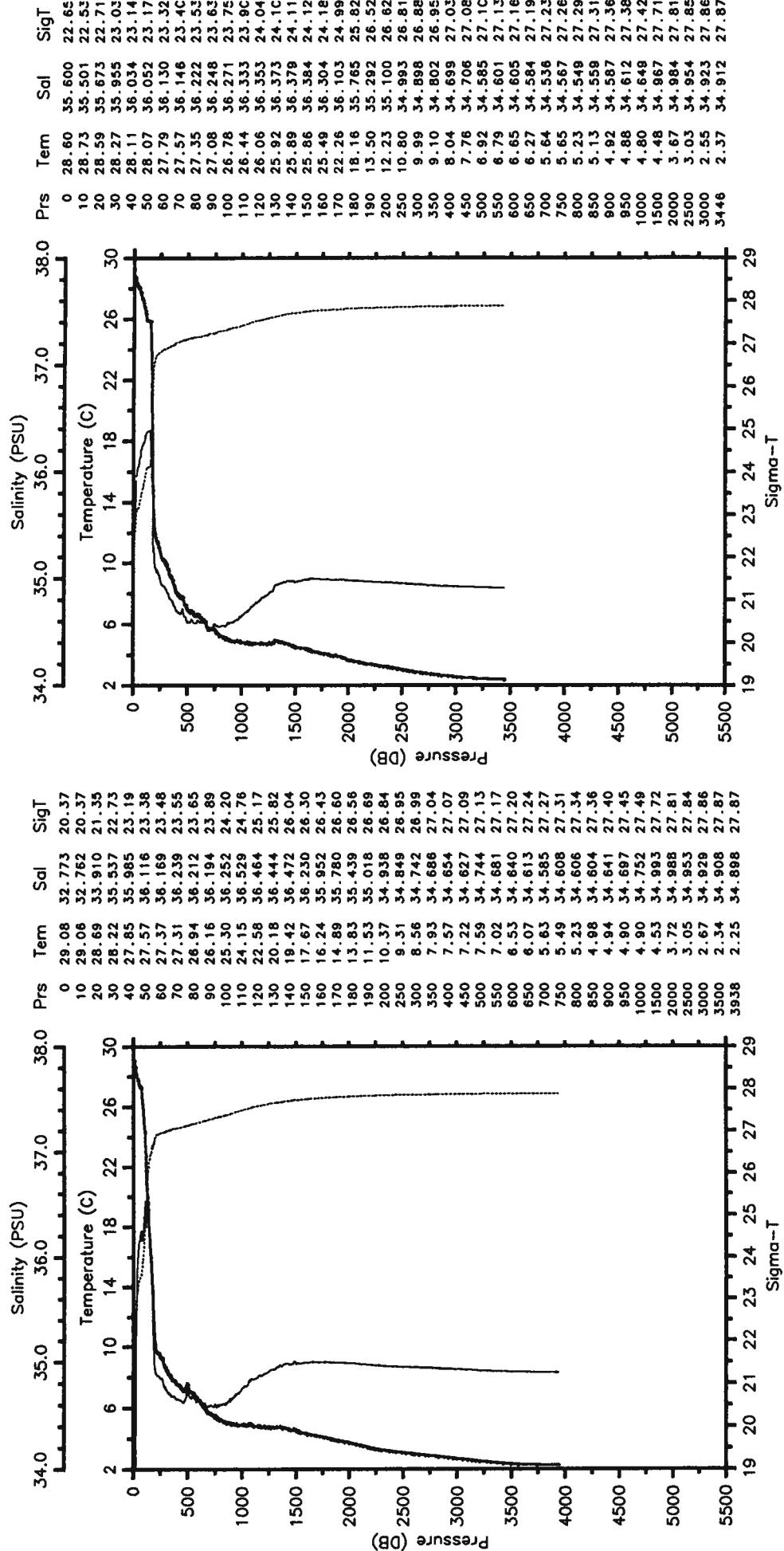
— Tem — Sal  
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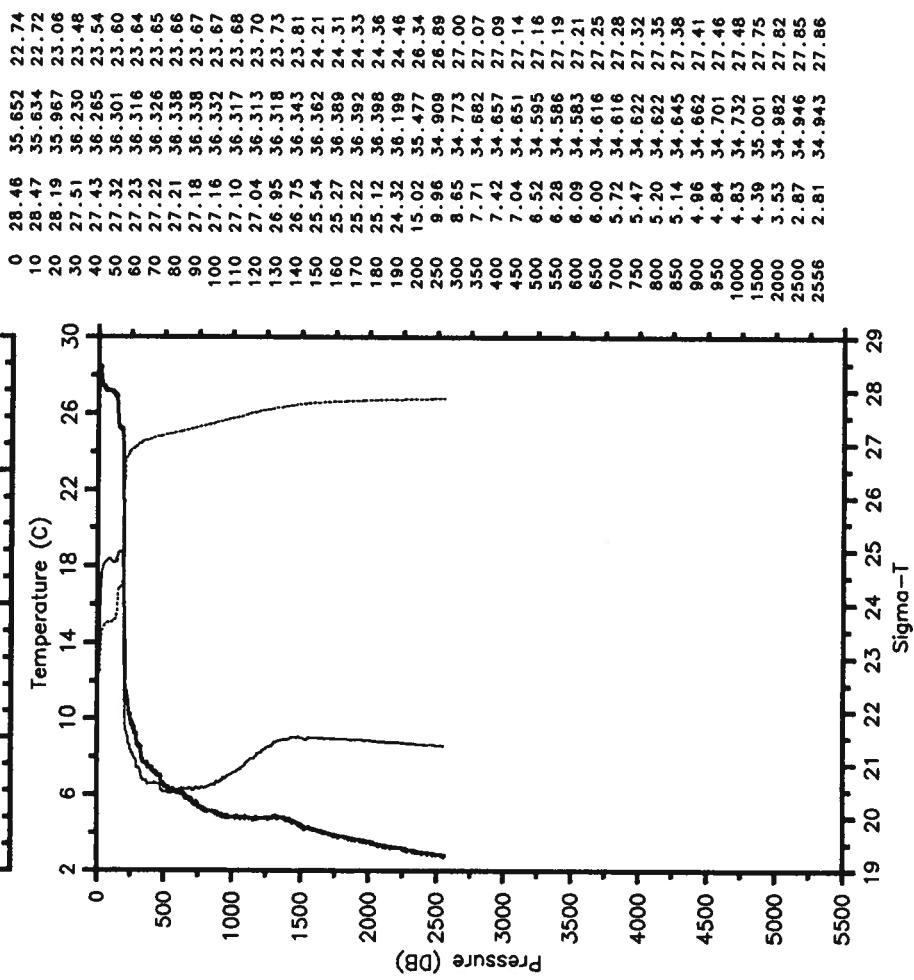
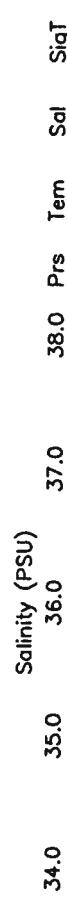


MIT-STACS32-88 CTD 9 MT MITCHELL  
 Date 09 16 88 Latitude 6.597 N  
 Time 1515 Z Longitude 48.280 W

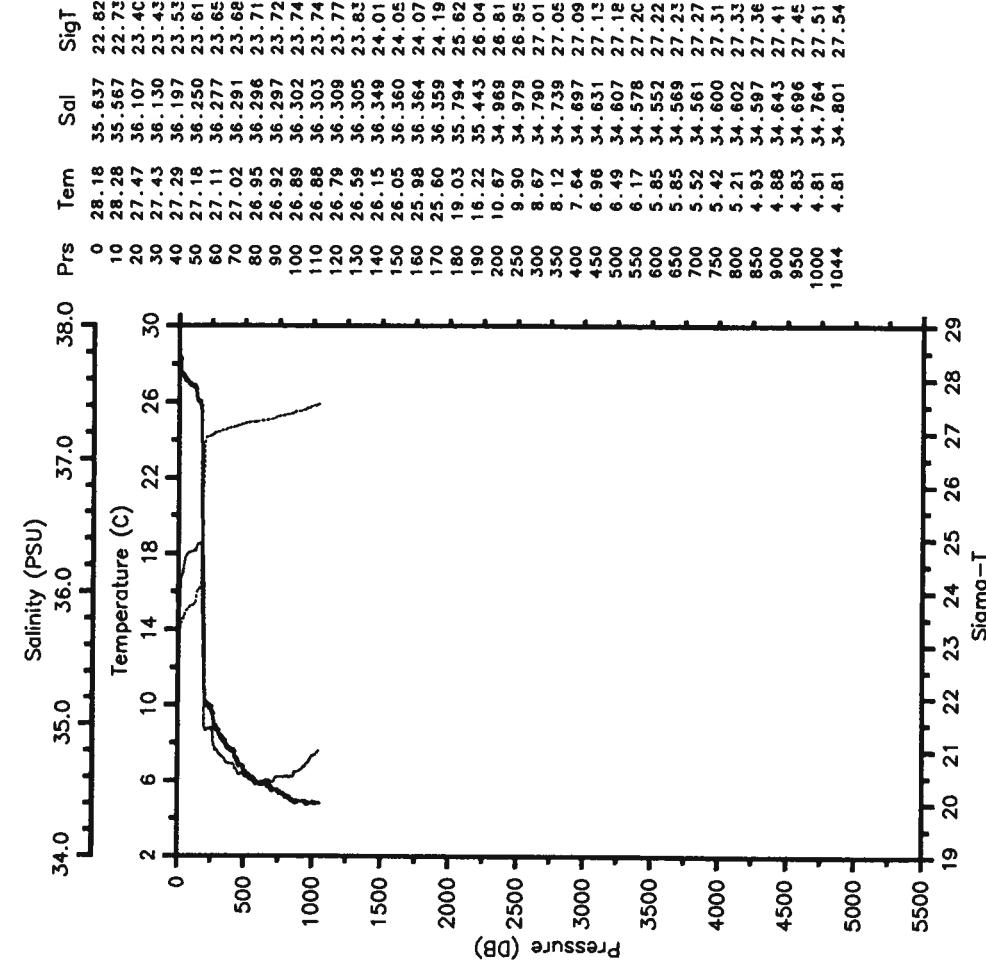
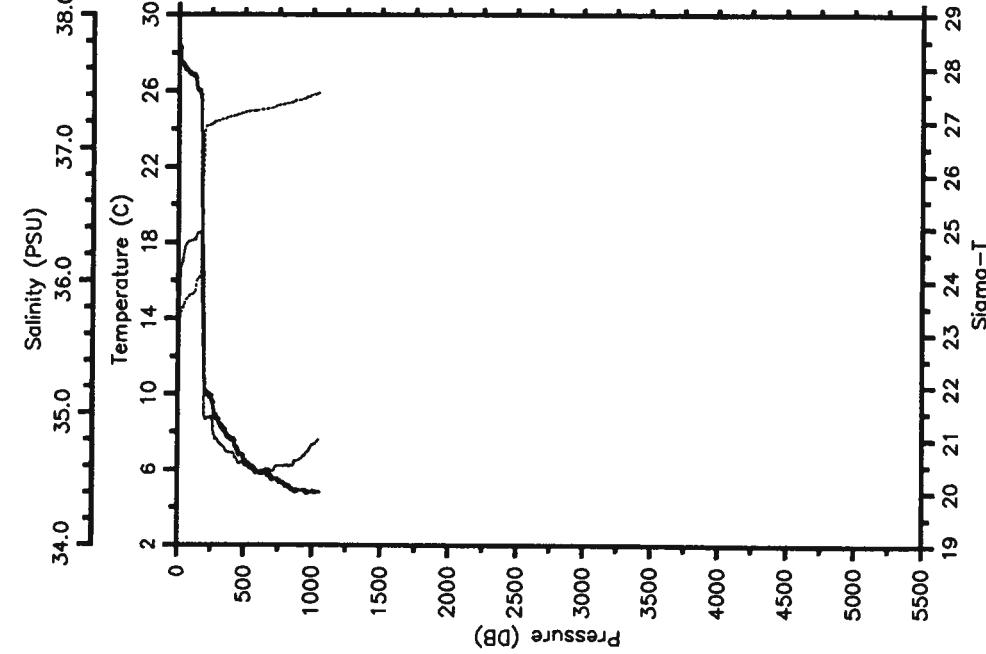
— Tem — Sal  
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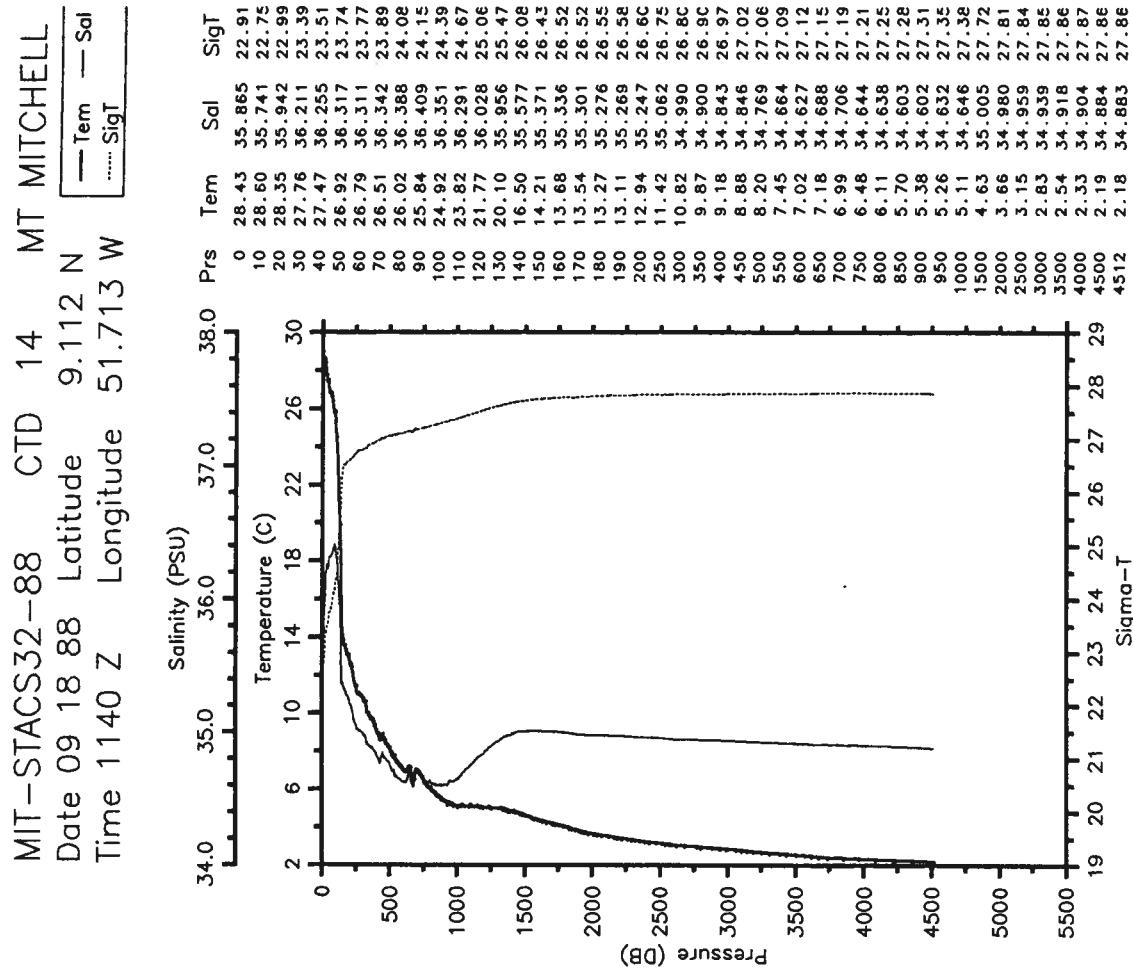
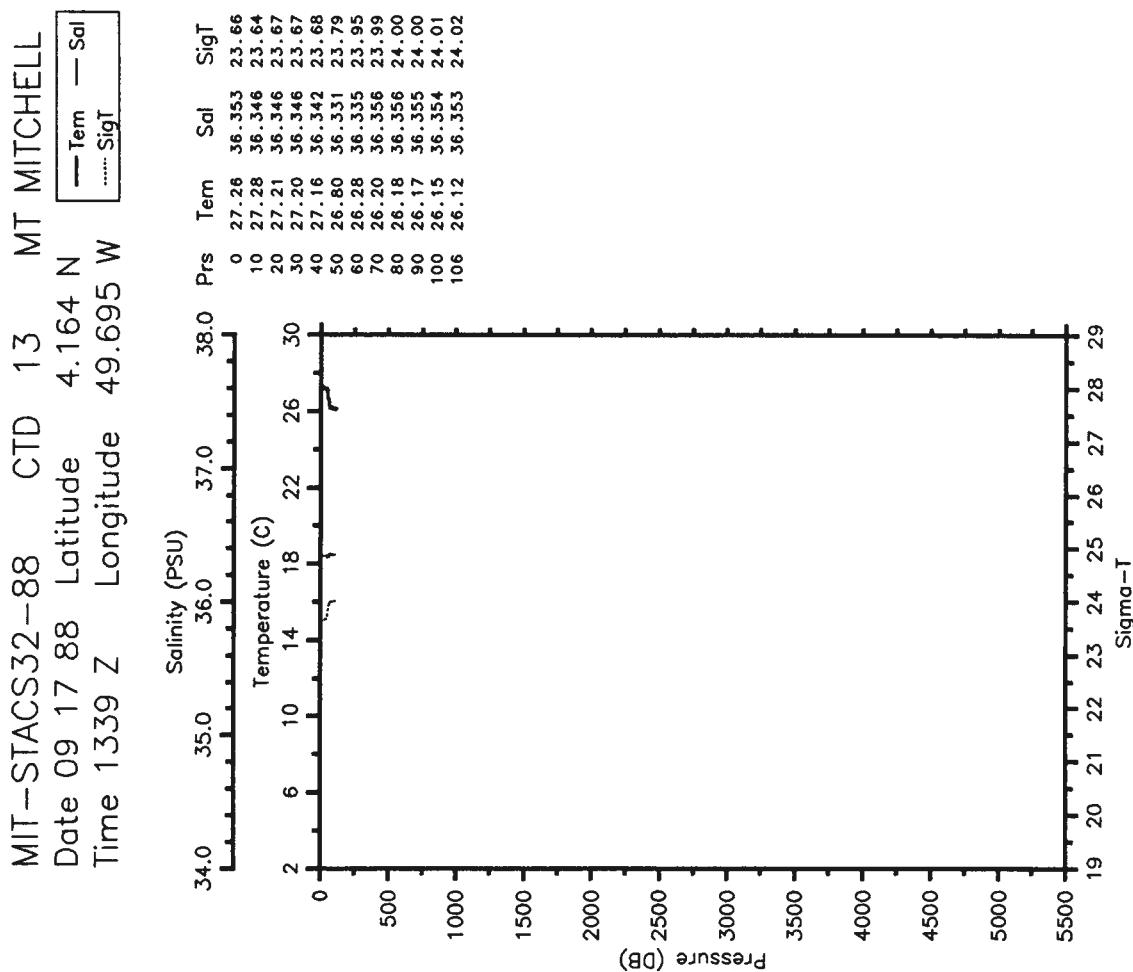


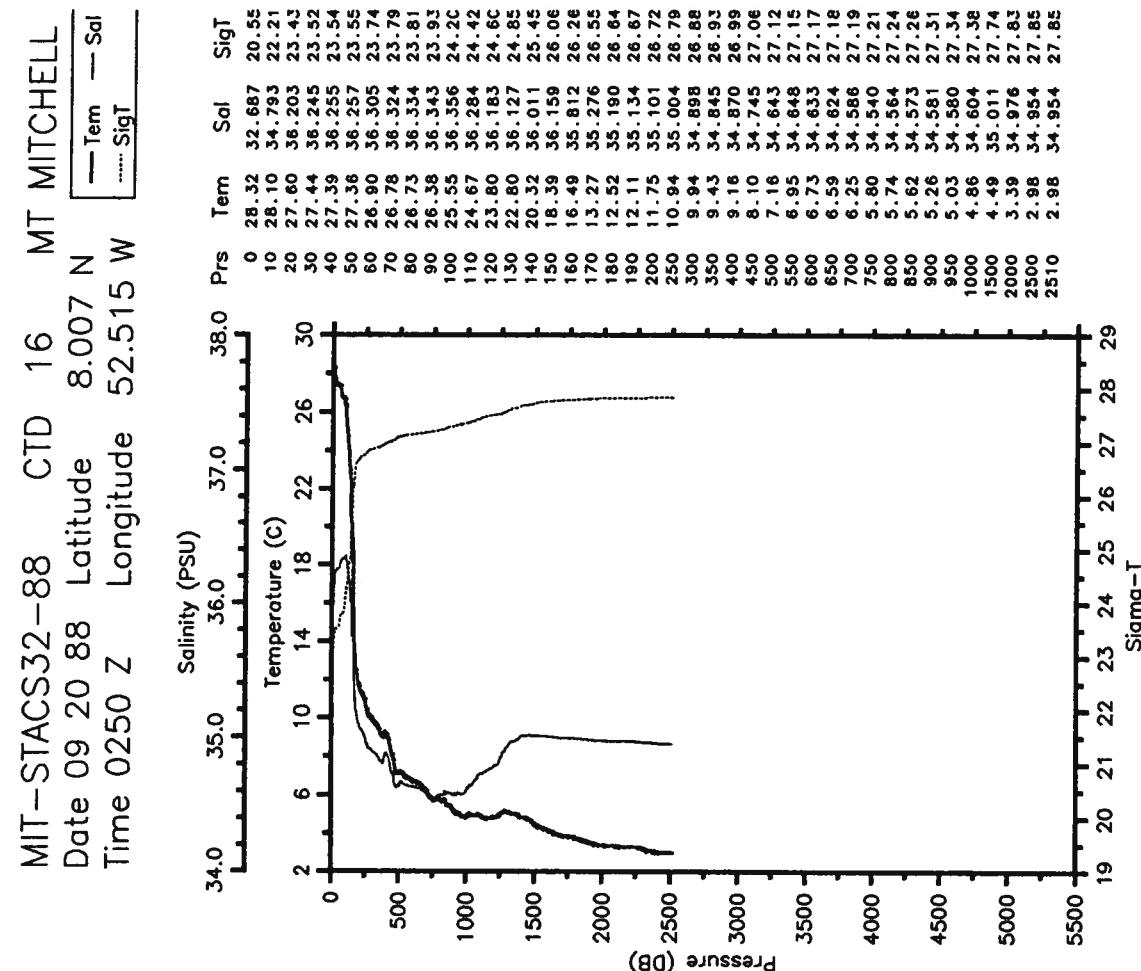
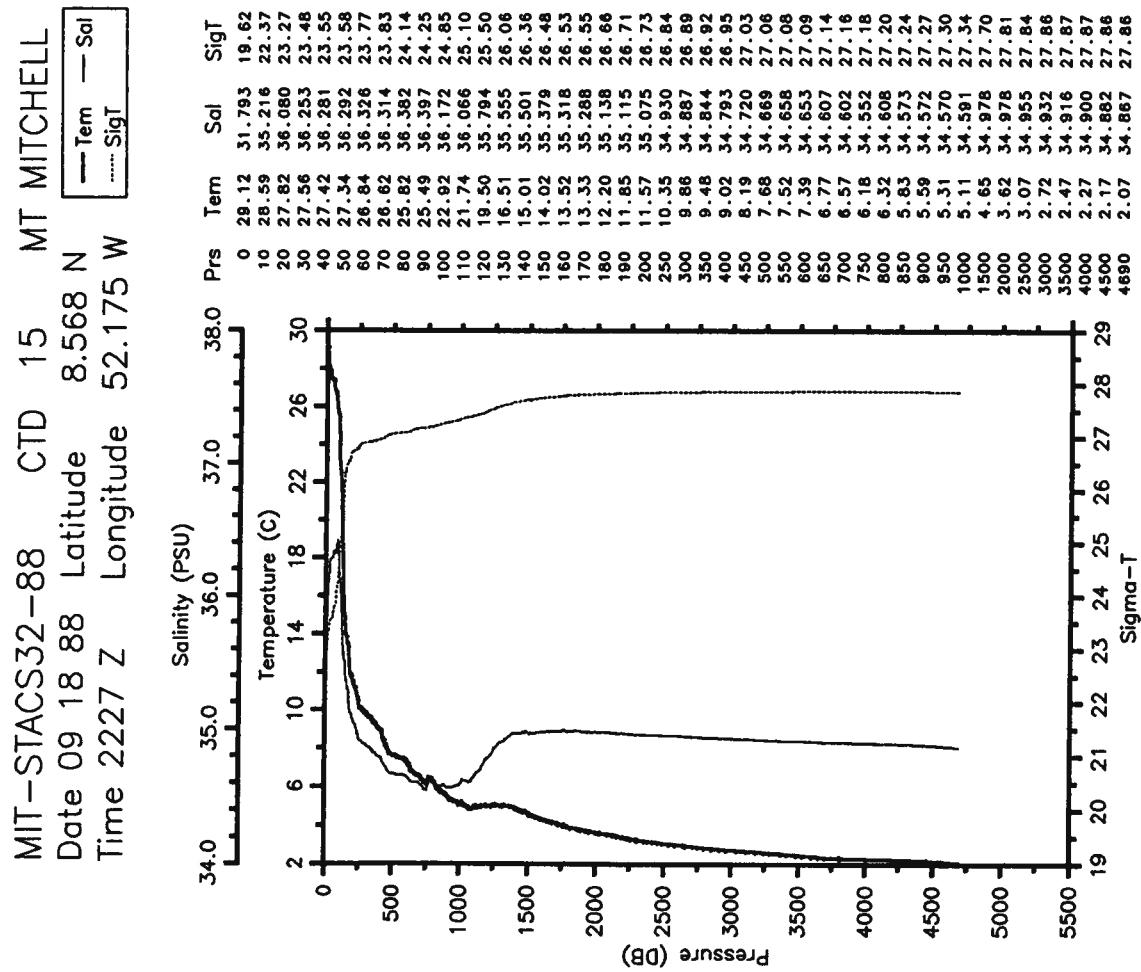
MIT-STACCS32-88 CTD 11 MT MITCHELL  
 Date 09 17 88 Latitude 4.878 N  
 Time 0518 Z Longitude 49.312 W

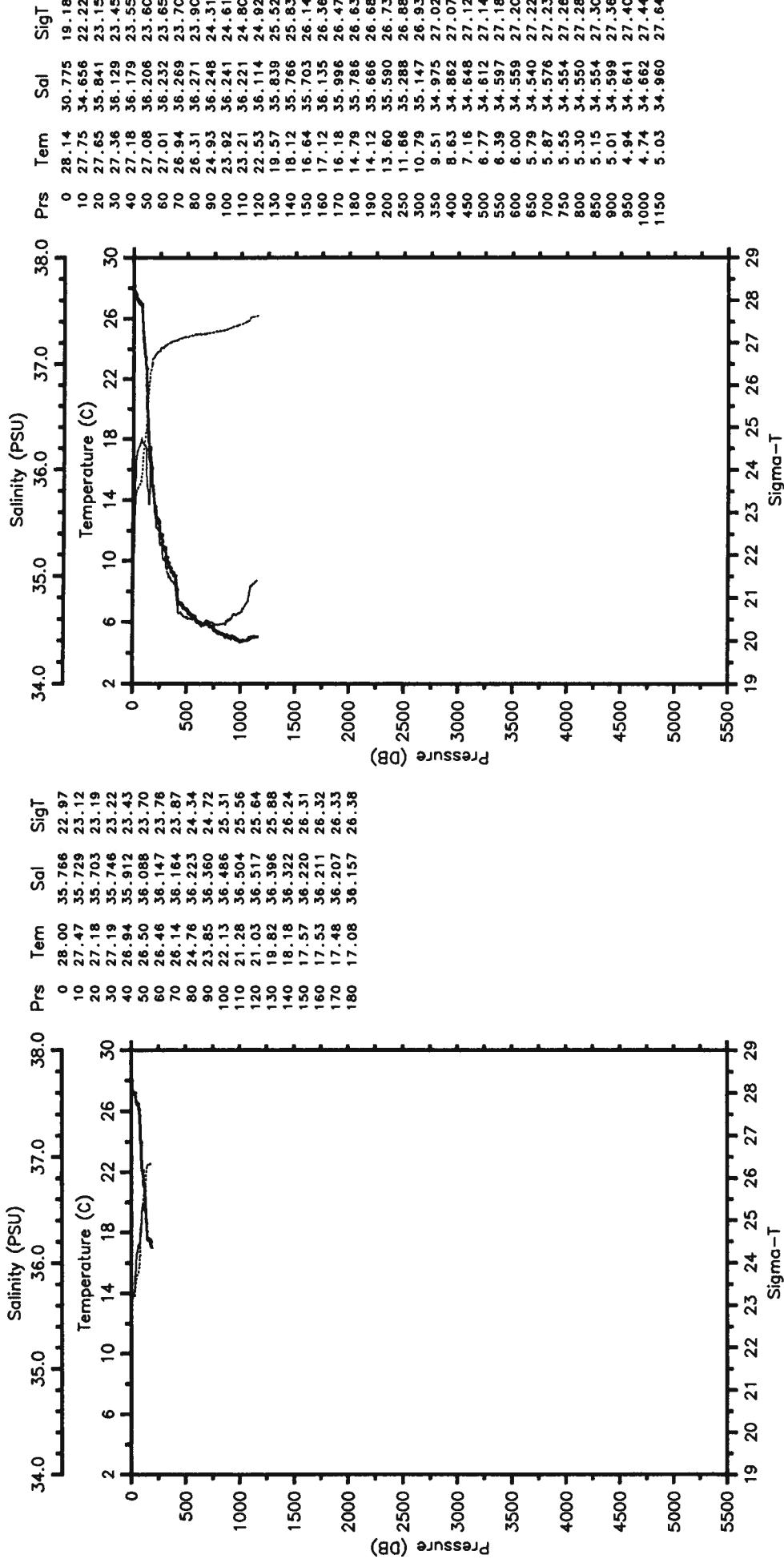


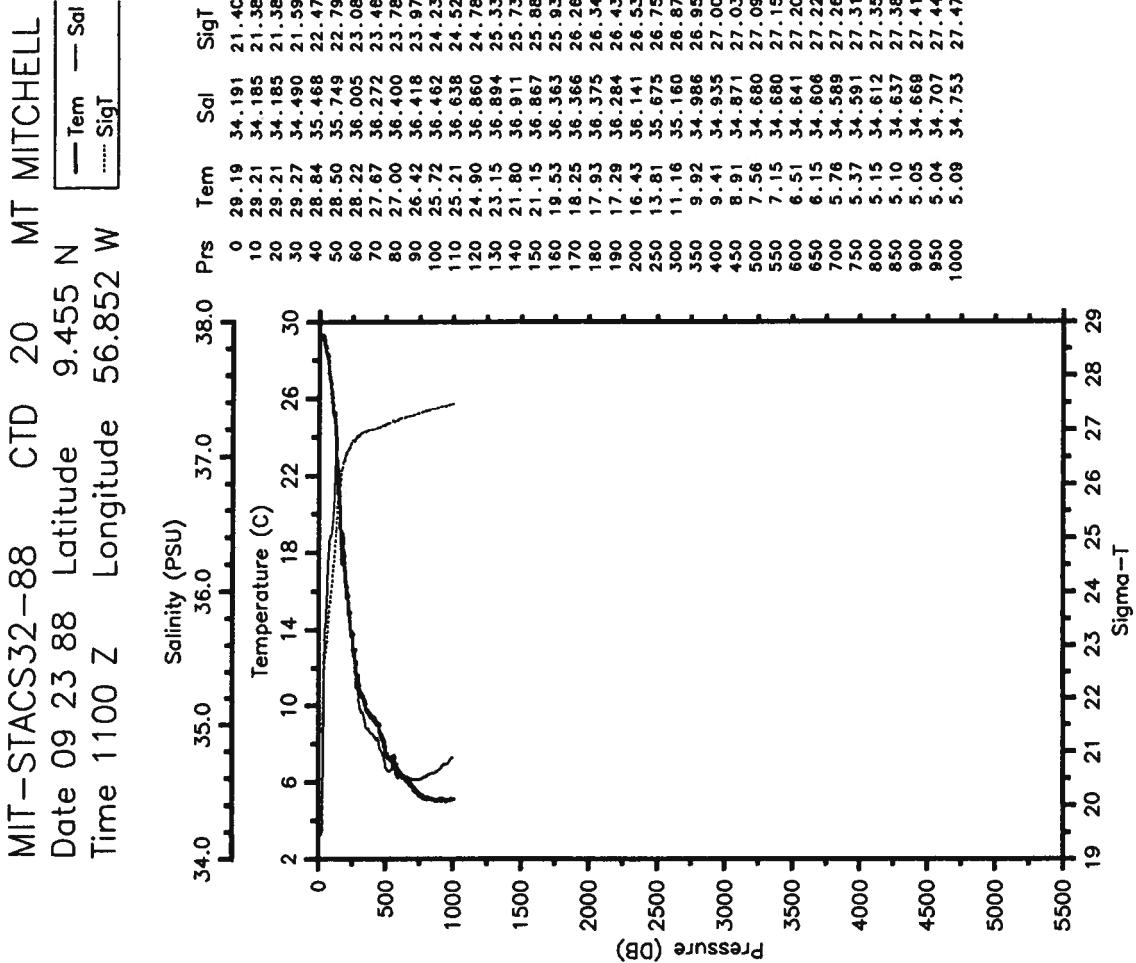
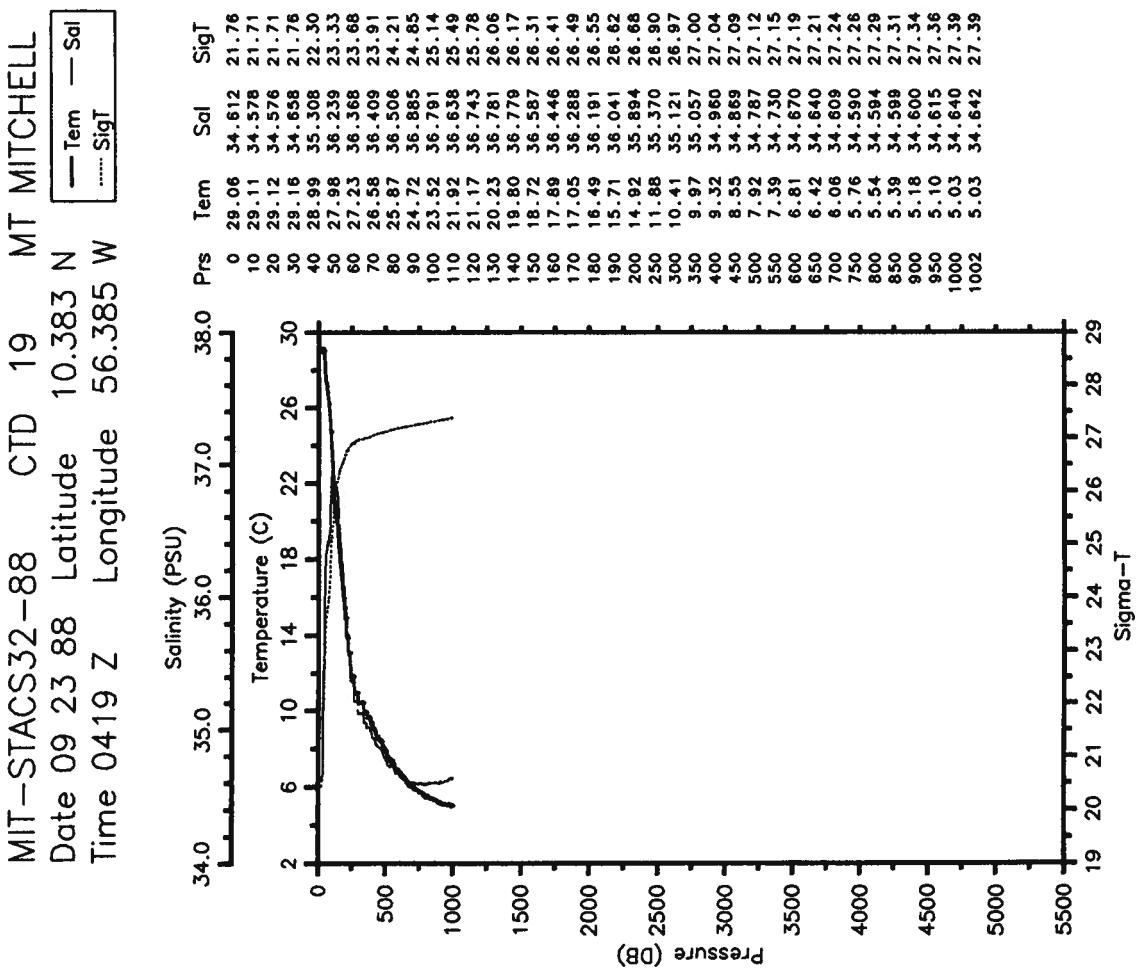
MIT-STACCS32-88 CTD 12 MT MITCHELL  
 Date 09 17 88 Latitude 4.405 N  
 Time 1018 Z Longitude 49.580 W





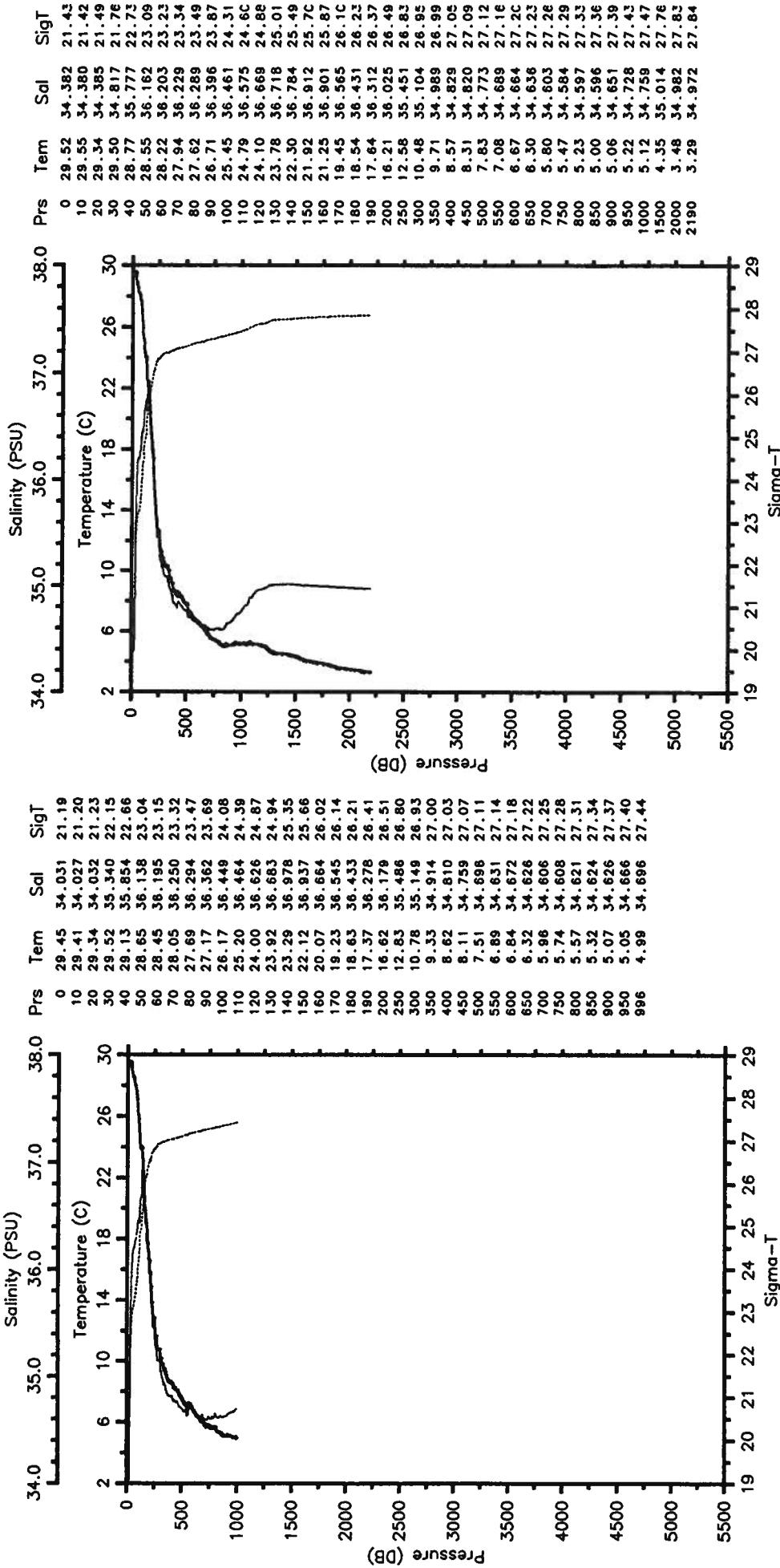
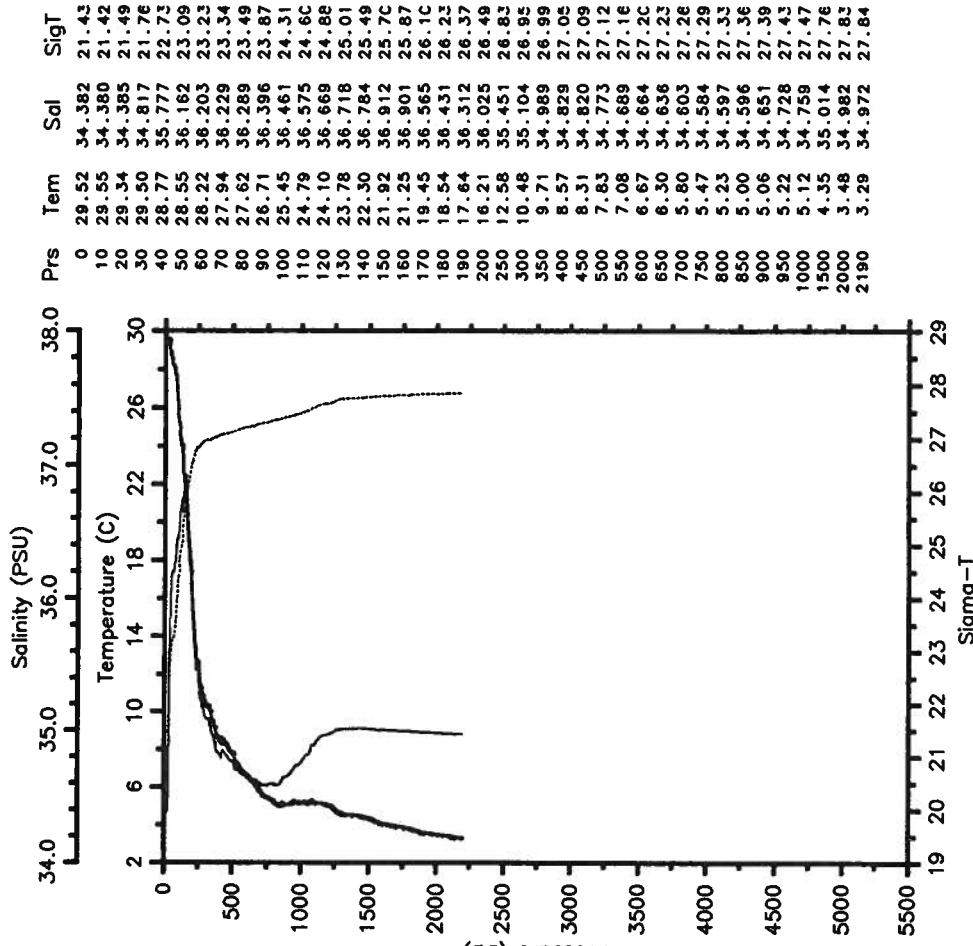


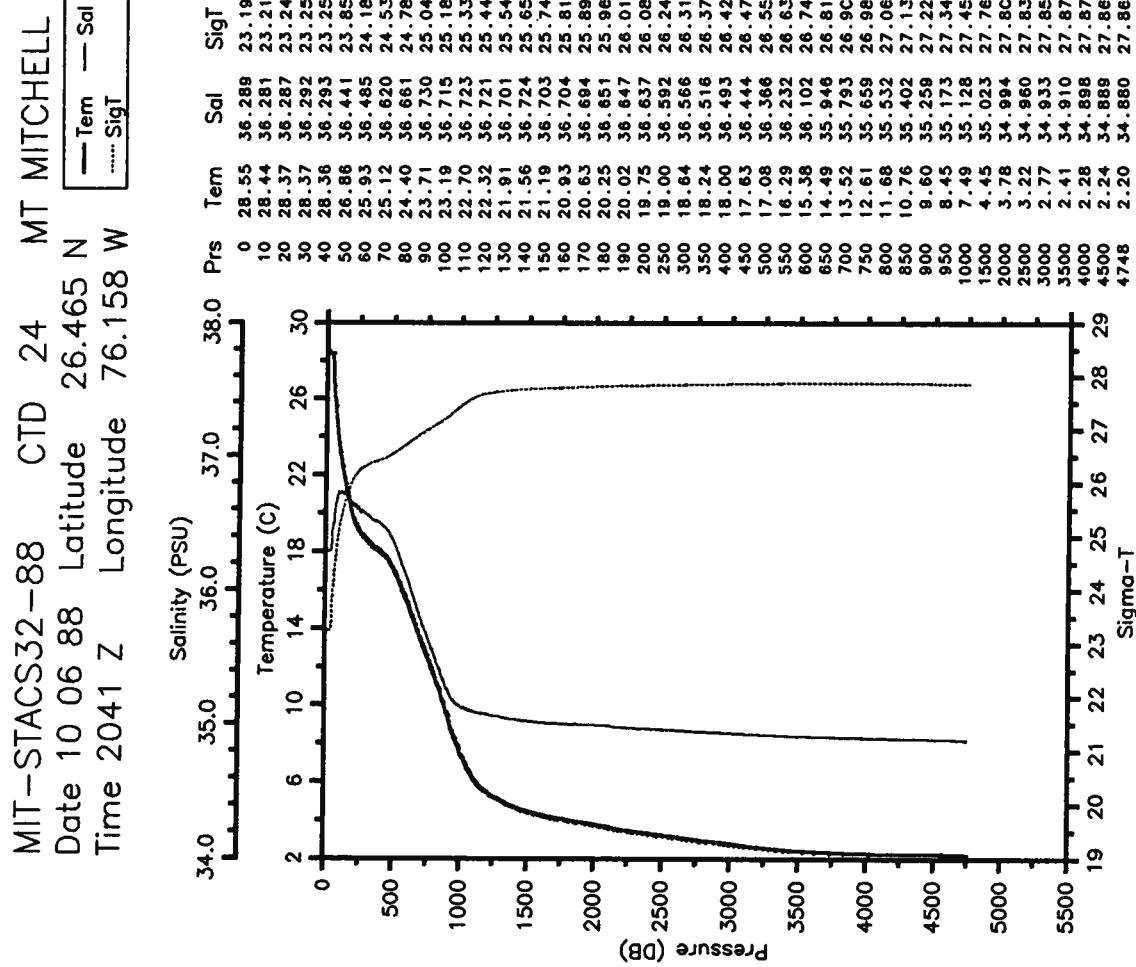
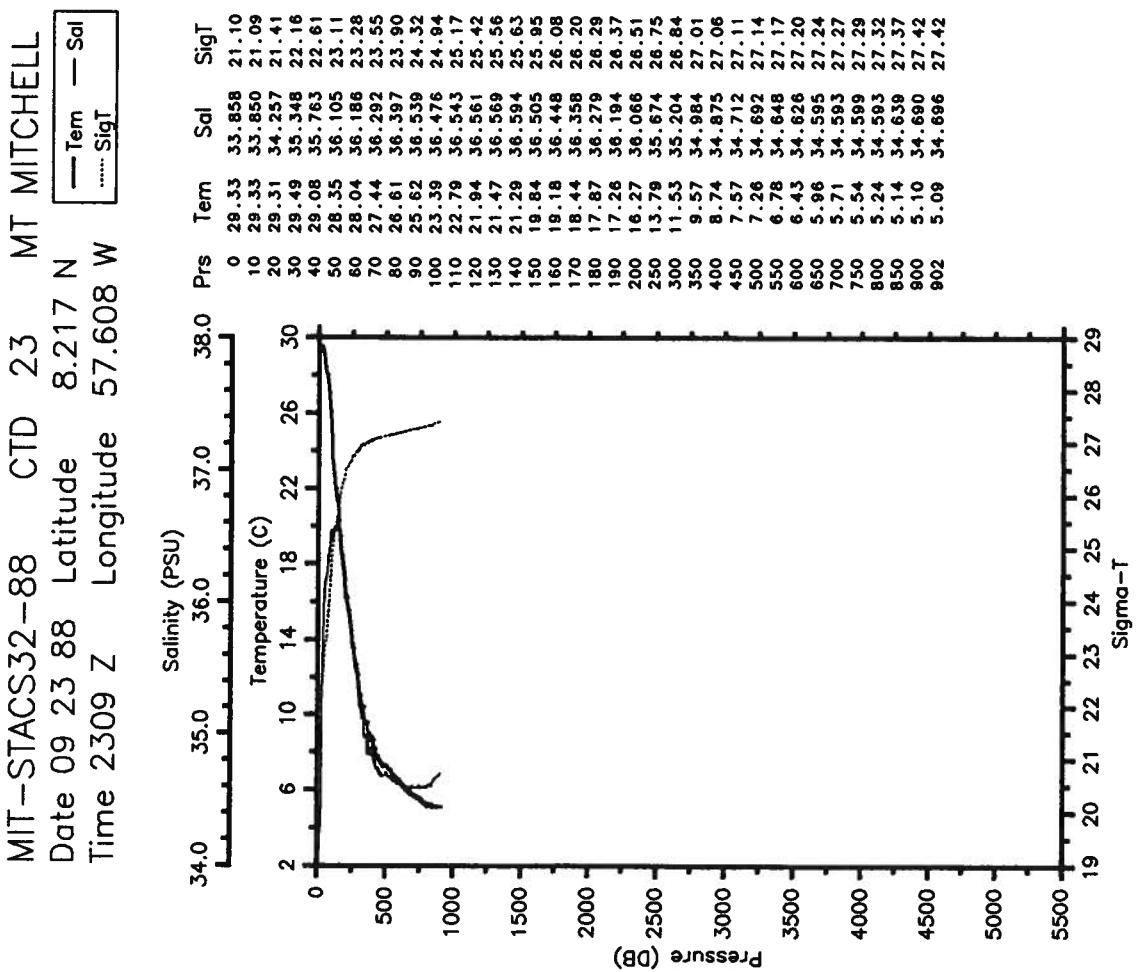




MIT-STACCS32-88 CTD 21 MT MITCHELL  
 Date 09.23 88 Latitude 9.022 N  
 Time 1522 Z Longitude 57.178 W

MIT-STACCS32-88 CTD 22 MT MITCHELL  
 Date 09.23 88 Latitude 8.548 N  
 Time 1922 Z Longitude 57.467 W

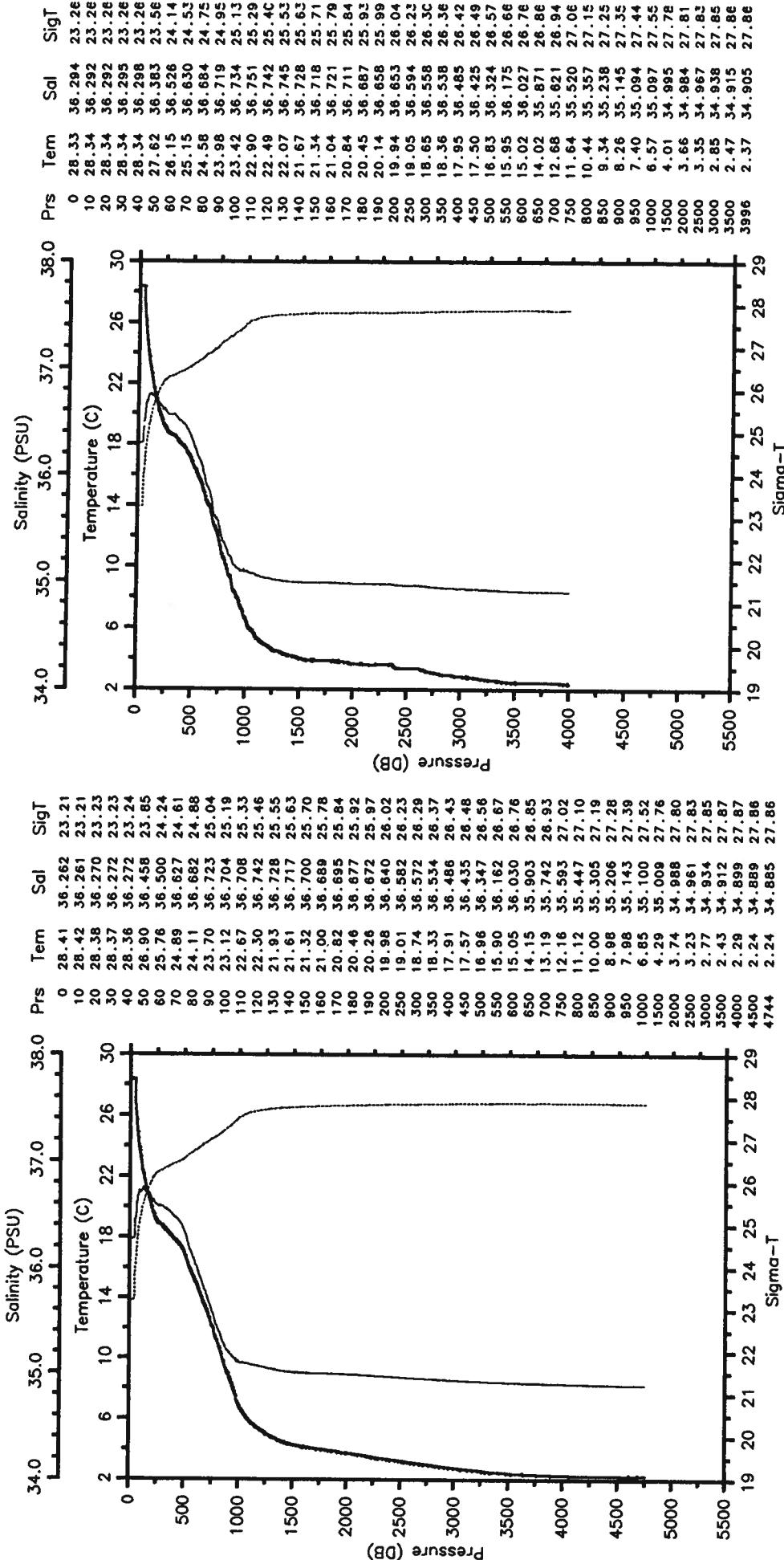


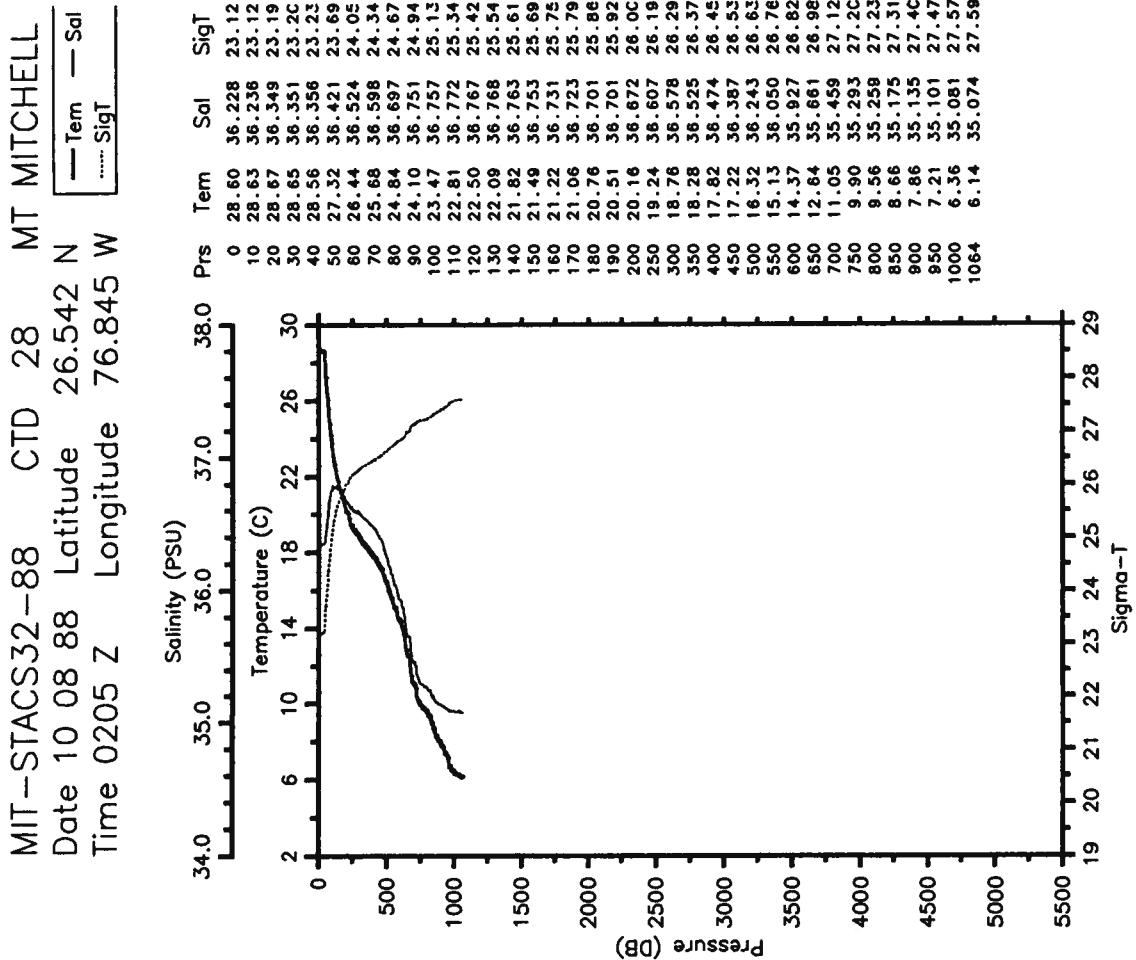
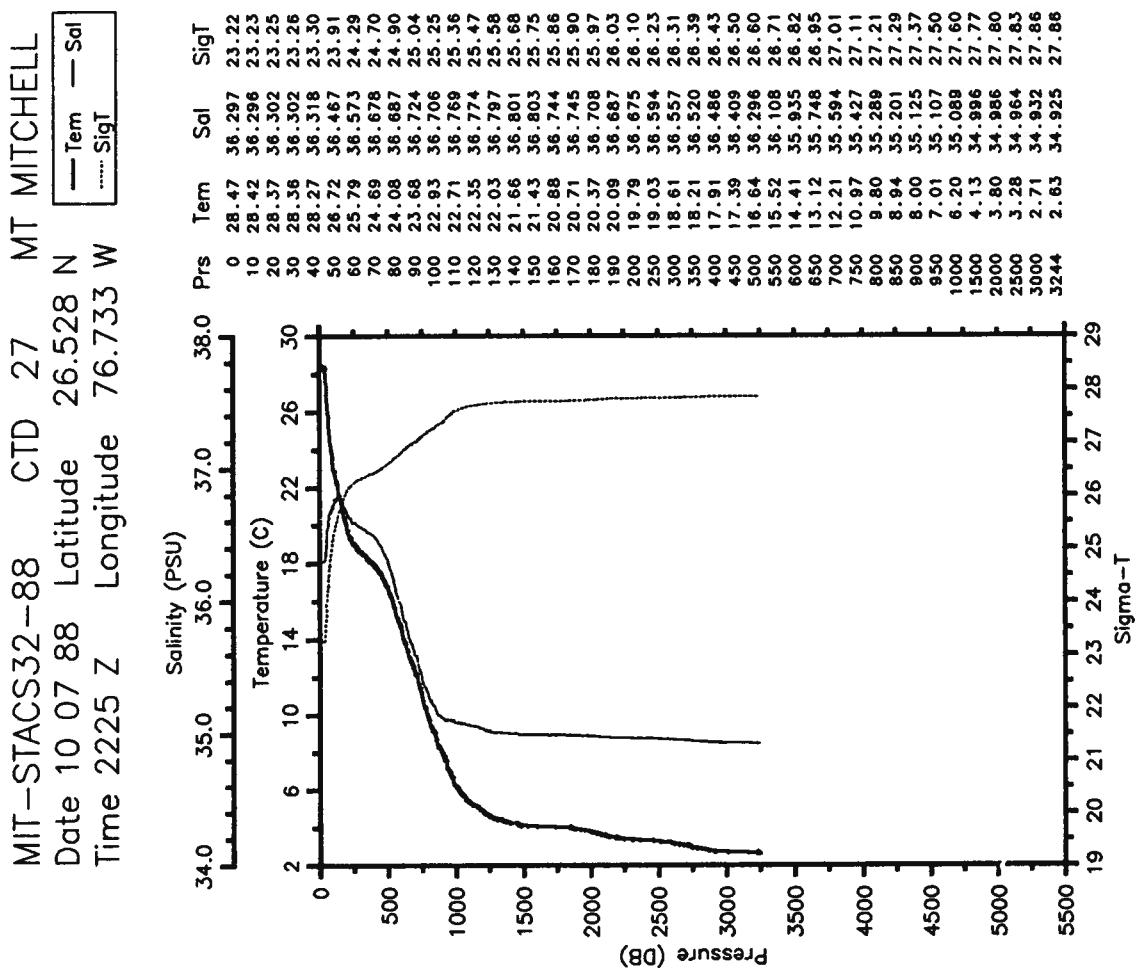


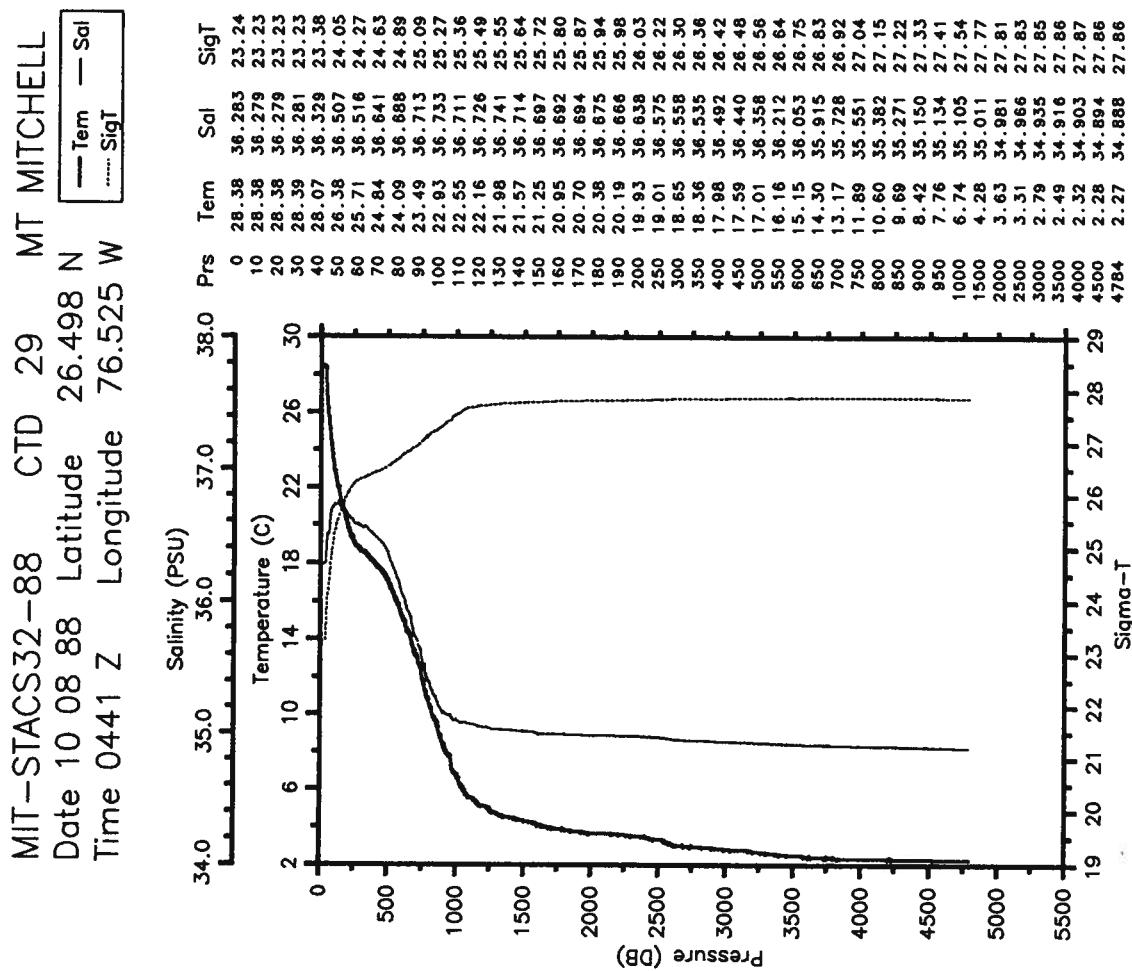
MIT-STACCS32-88 CTD 25 MT MITCHELL  
 Date 10 07 88 Latitude 26.470 N  
 Time 0118 Z Longitude 76.345 W

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Salinity (PSU)  
 Temperature (C)  
 Pressure (DB)







#### **APPENDIX C: XBT DATA**

Casts are presented by cruise and increasing cast number. Isotherm depths in meters are listed at temperatures ranging from 30 to 6 degrees Centrigrade.

## ISOTHERM DEPTHS (M)

R/V WHITING

WHI-STACS30-88

XBT NO.	1	2	3	4	5	6	7
YEAR	88	88	88	88	88	88	88
MONTH	2	2	2	2	2	2	2
DAY (GMT)	19	20	25	25	26	26	27
TIME (GMT)	1624	1450	0814	2044	0846	2025	0855
LAT (N)	29.43	26.23	26.17	24.50	23.23	21.93	20.68
LON (W)	79.99	79.95	77.09	74.50	72.49	70.47	68.50
SURF T (C)	24.5	23.4	23.3	25.5	24.4	25.9	25.5
28							
27							
26							
25							
24	62			24		123	128
23	71	27	39	107	123	167	188
22	91	59	119	134	183	181	221
21	112	78	193	167	207	207	238
20	121	87	207	195	235	239	261
19	128	94	234	243	278	284	289
18	137	102	328	328	364	362	325
17	147	108	404	400	447	438	379
16	168	113	478	461	507	479	408
15	189	121	518	510	559	524	461
14	207	126	556	561	609	578	516
13	233	132	619	597	654	628	572
12	250	136	655	648	698	679	625
11	269	142	704	688	740	728	658
10	298	160	736	735	782	768	721
9	348		804	797	836	835	773
8			861	877	894	899	841
7			939	959	960	923	
6			1020	1053	1051	1074	

## ISOTHERM DEPTHS (M)

R/V WHITING

WHI-STACS30-88

XBT NO.	8	9	10	11	12	13	14
YEAR	88	88	88	88	88	88	88
MONTH	2	2	2	2	2	3	3
DAY (GMT)	27	28	28	29	4	5	5
TIME (GMT)	2036	0843	2044	0839	2049	0811	2203
LAT (N)	19.34	17.83	16.39	15.07	13.49	13.01	13.00
LON (W)	66.50	65.10	63.42	61.81	61.09	60.31	58.01
SURF T (C)	25.6	26.0	26.7	26.8	26.5	26.5	26.6
28							
27							
26							
25							
24	99	105	100	104	71	81	116
23	137	128	116	127	82	88	133
22	151	153	132	139	118	91	153
21	187	192	159	168	136	95	162
20	211	210	174	186	141	107	169
19	230	231	195	206	153	125	176
18	251	254	214	212	159	146	192
17	303	277	227	229	179	184	209
16	366	314	262	254	196	197	224
15	408	368	287	293	234	212	236
14	444	401	309	316	254	237	241
13	474	437	350	333	290	253	283
12	515	475	383	357	306	262	300
11	556	506	427	394	325	285	314
10	667	587	503	469	405	412	404
9		664	558	494			
8		725	615	550			
7		827	740	604			
6		972	870				

## ISOTHERM DEPTHS (M)

R/V WHITING

WHI-STACS30-88

XBT NO.	15	16	17	18	19	20	21
YEAR	88	88	88	88	88	88	88
MONTH	3	3	3	3	3	3	3
DAY (GMT)	6	7	7	7	8	8	8
TIME (GMT)	0820	0819	1750	1936	0309	0858	1035
LAT (N)	12.99	13.00	13.00	13.00	13.01	12.74	12.48
LON (W)	57.99	55.58	54.65	54.32	53.31	52.78	52.59
SURF T (C)	26.1	26.0	26.1	26.2	25.8	26.2	26.2
28							
27							
26	108	85	84	83		87	93
25	117	96	91	95	70	93	100
24	127	107	107	107	74	96	111
23	135	119	117	115	77	104	118
22	141	132	133	124	82	111	126
21	158	144	142	130	91	116	131
20	164	156	154	137	111	124	142
19	178	172	169	158	126	144	154
18	181	192	186	172	134	161	176
17	190	208	202	196	147	180	187
16	215	223	216	211	167	206	203
15	225	240	237	228	183	225	238
14	247	282	256	249	206	247	258
13	259	304	277	275	235	264	283
12	269	336	295	291	269	298	304
11	287	364	333	328	301	342	346
10	323		370	360	348	373	379
9	348		416	412	399		
8							
7							
6							

## ISOTHERM DEPTHS (M)

R/V WHITING

WHI-STACS30-88

XBT NO.	22	23	24	25	26	27	28
YEAR	88	88	88	88	88	88	88
MONTH	3	3	3	3	3	3	3
DAY (GMT)	8	8	9	9	9	9	9
TIME (GMT)	1640	1827	0011	0206	0756	0935	1524
LAT (N)	11.93	11.68	11.13	10.89	10.33	10.05	9.52
LON (W)	52.18	51.98	51.58	51.44	51.00	50.78	50.38
SURF T (C)	26.2	26.5	26.2	26.2	26.5	26.5	26.4
28							
27							
26							
25	94	88	80	80	84	89	84
24	99	97	84	84	89	91	89
23	109	106	89	89	104	98	95
22	114	113	97	97	110	107	101
21	121	125	113	106	117	114	110
20	131	133	117	127	126	123	120
19	139	138	127	139	134	134	132
18	147	148	134	152	144	146	144
17	173	165	141	164	156	153	161
16	194	179	148	176	166	168	174
15	213	197	155	186	177	178	182
14	242	208	165	195	190	183	191
13	270	251	183	220	221	200	200
12	286	279	211	234	245	217	218
11	310	311	235	278	287	240	279
10	373		360	288	300	320	288
9	402		388	379	344	339	383
8					417	390	
7							
6							

## ISOTHERM DEPTHS (M)

R/V WHITING		WHI-STACS30-88					
XBT NO.	29	30	31	32	33	34	35
YEAR	88	88	88	88	88	88	88
MONTH	3	3	3	3	3	3	3
DAY (GMT)	9	9	10	10	10	10	10
TIME (GMT)	1715	2234	0026	0651	1230	2003	2329
LAT (N)	9.23	8.70	8.43	7.87	7.28	7.32	7.64
LON (W)	50.16	49.77	49.57	49.15	48.72	49.10	49.70
SURF T (C)	26.3	26.4	26.3	26.3	26.6	26.8	26.4
28							
27							
26	78	77	76	72	56	48	68
25	85	80	80	75	59	52	79
24	92	84	88	78	64	58	83
23	100	89	98	86	70	61	87
22	108	93	101	91	74	78	92
21	119	107	103	103	78	84	97
20	127	112	116	106	83	91	102
19	135	118	132	113	88	100	114
18	144	127	141	119	93	104	119
17	154	135	151	131	98	110	124
16	163	144	160	138	106	114	134
15	176	154	169	144	116	123	148
14	190	164	178	151	122	132	158
13	208	170	204	167	128	142	185
12	218	187	228	191	138	154	195
11	268	219	251	211	151	167	216
10	311	279	277	256	190	203	254
9	389		356	302	277	260	298
8				391	359	365	335
7							
6							

## ISOTHERM DEPTHS (M)

R/V WHITING		WHI-STACS30-88					
XBT NO.	36	37	38	39	40	41	42
YEAR	88	88	88	88	88	88	88
MONTH	3	3	3	3	3	3	3
DAY (GMT)	11	11	11	12	12	12	12
TIME (GMT)	0845	1227	2053	0051	0936	1427	1815
LAT (N)	8.27	8.59	9.23	9.57	10.22	10.64	10.93
LON (W)	50.91	51.50	52.68	53.28	54.47	55.26	55.74
SURF T (C)	27.2	27.3	27.5	27.4	26.6	26.7	27.2
28							
27							
26	104	56	77	88			18
25	110	83	100	97	89	88	94
24	113	93	109	100	94	94	104
23	117	107	124	111	99	98	110
22	122	115	141	118	109	112	115
21	140	125	152	137	117	125	126
20	143	135	160	146	126	143	158
19	148	144	166	158	137	152	167
18	161	147	169	171	148	161	173
17	170	158	171	188	161	167	193
16	176	166	175	197	170	178	205
15	185	176	179	207	183	203	218
14	195	182	206	221	199	215	232
13	207	207	230	243	216	228	254
12	215	222	240	269	240	252	279
11	241	238	260	290	257	296	325
10	283	289	309	283	360	378	
9	351	331	363				
8	404						
7							
6							

## ISOTHERM DEPTHS (M)

R/V WHITING		WHI-STACS30-88					
XBT NO.	43	44	45	46	47	48	49
YEAR	88	88	88	88	88	88	88
MONTH	3	3	3	3	3	3	3
DAY (GMT)	16	17	17	18	19	19	20
TIME (GMT)	1654	0439	1631	1629	0430	1628	0436
LAT (N)	13.37	15.05	16.78	19.87	21.38	22.81	24.21
LON (W)	60.10	61.76	63.40	66.80	68.50	70.29	72.35
SURF T (C)	27.0	26.6	27.3	25.5	25.4	25.5	24.0
28							
27							
26	88	69	5	81			
25	92	97	101	112	55	94	
24	100	102	122	126	98	144	15
23	104	111	151	150	124	151	64
22	128	130	172	175	149	175	92
21	142	153	187	204	166	199	123
20	148	167	204	233	197	222	149
19	158	187	226	260	220	260	193
18	167	212	249	313	303	341	293
17	180	233	280	367	381	415	370
16	185	267	299	409	432	424	
15	191	282	318				
14	199	312	341				
13	237	329	368				
12	271	365	403				
11	385	408					
10	429	433					

## ISOTHERM DEPTHS (M)

R/V WHITING		WHI-STACS30-88					
XBT NO.	50	51	52	53	54	55	56
YEAR	88	88	88	88	88	88	88
MONTH	3	3	3	3	3	3	3
DAY (GMT)	20	21	21	21	22	22	23
TIME (GMT)	1629	0429	1541	2102	1431	1931	0054
LAT (N)	25.53	26.45	26.49	26.47	26.51	26.57	26.53
LON (W)	74.15	75.53	75.93	76.15	76.49	76.63	76.74
SURF T (C)	23.2	22.9	23.1	23.5	23.0	23.5	23.2
28							
27							
26							
25							
24							
23	80		64	14	16	68	88
22	112	98	108	46	105	88	151
21	141	146	146	90	154	158	184
20	163	178	185	131	183	179	210
19	225		233	257	220	218	242
18	321		343	394	367	337	334
17	390		422	477	471	432	426
16			519	507	517	495	487
15			560	560	568	538	525
14			606	606	612	584	572
13			650	642	653	619	621
12			701	699	699	668	655
11			748	742	750	719	709
10			796	794	787	772	773
9			855	844	825	817	834
8			917	900	885	872	871
7			991	975	950	921	922
6			1090	1060	1029	1012	1010

## ISOTHERM DEPTHS (m)

R/V WHITING

WHI-STACS30-68

XBT NO.	57	58
YEAR	88	88
MONTH	3	3
DAY (GMT)	23	24
TIME (GMT)	0331	0428
LAT (N)	26.55	27.32
LON (W)	76.84	77.60
SURF T (C)	23.1	23.2
	28	
	27	
	26	
	25	
	24	
	23	94
	22	134
	21	163
	20	189
	19	226
	18	316
	17	395
	16	446
	15	
	14	
	13	
	12	
	11	
	10	
	9	
	8	
	7	
	6	

## ISOTHERM DEPTHS (M)

R/V WHITING WHI-STAC831-88

XBT NO.	1	2	3	4	5	6	7
YEAR	88	88	88	88	88	88	88
MONTH	7	7	7	7	7	7	7
DAY (GMT)	1	5	6	6	6	8	8
TIME (GMT)	0545	2241	0351	0928	1423	0853	1840
LAT (N)	15.05	11.75	10.87	9.54	9.00	10.98	10.45
LON (W)	62.58	58.08	58.70	55.79	57.93	55.48	54.63
SURF T (C)	28.2	27.8	27.9	25.0	27.9	27.9	27.8
29							
28	44						
27	63	29	44		34	43	41
26	82	62	74		67	75	68
25	102	109	87	48	76	86	83
24	115	121	90	83	86	91	86
23	131	125	109	86	92	98	91
22	146	132	119	90	100	107	97
21	159	143	123	107	111	116	101
20	170	152	130	113	121	120	110
19	181	161	153	125	126	126	121
18	201	193	163	134	130	132	127
17	233	217	170	142	158	138	138
16	264	227	189	154	172	147	154
15	291	231	206	167	179	172	169
14	325	244	217	181	189	195	190
13	359	263	225	200	207	202	196
12	398	292	246	226	228	236	220
11	430	329	295	272	252	279	270
10		359	349	335	292	325	307
9		410	411		354	399	351
8					424		427
7							

## ISOTHERM DEPTHS (M)

R/V WHITING WHI-STAC831-88

XBT NO.	8	9	10	11	12	13	14
YEAR	88	88	88	88	88	88	88
MONTH	7	7	7	7	7	7	7
DAY (GMT)	9	9	9	9	10	10	10
TIME (GMT)	0139	0821	1511	2143	0403	1016	1615
LAT (N)	9.95	9.48	8.95	8.38	7.83	7.32	6.92
LON (W)	53.78	52.88	52.05	51.17	50.30	49.47	48.73
SURF T (C)	27.5	27.5	27.8	29.0	28.8	28.6	27.9
29							
28							
27		21	35	34	79	71	41
26		74	64	81	88	85	75
25		82	79	87	93	91	88
24		87	91	93	103	98	96
23		94	94	99	113	101	99
22		104	101	107	115	104	102
21		114	108	111	118	110	111
20		121	115	121	123	114	116
19		127	130	147	127	120	121
18		142	141	154	131	130	124
17		163	153	160	137	144	131
16		177	163	165	141	156	134
15		182	177	175	150	160	139
14		192	186	188	159	170	146
13		204	202	209	180	183	160
12		216	232	231	193	203	182
11		242	258	257	212	227	202
10		261	280	321	249	245	264
9		308	308	372	287	319	313
8		412	402		370	407	414
7					442		377

## ISOTHERM DEPTHS (M)

R/V WHITING WHI-STAC831-88

XBT NO.	15	16	17	18	19	20	21
YEAR	88	88	88	88	88	88	88
MONTH	7	7	7	7	7	7	7
DAY (GMT)	12	12	12	12	12	12	12
TIME (GMT)	0203	0419	0648	0915	1142	1404	1646
LAT (N)	4.78	5.20	5.67	6.12	6.55	6.95	7.42
LON (W)	49.77	49.97	50.20	50.42	50.65	50.88	51.15
SURF T (C)	28.9	29.2	29.4	29.4	29.2	28.9	29.2
29		3	13	13	8	5	
28		15	34	55	54	60	51
27		60	61	84	89	100	84
26		81	76	94	103	112	99
25		90	85	102	114	115	105
24		104	100	108	118	116	106
23		110	108	113	122	119	108
22		116	113	119	125	123	109
21		125	119	124	128	127	111
20		141	130	128	134	130	114
19		146	138	134	138	135	117
18		155	143	137	142	143	119
17		165	150	141	149	150	121
16		171	156	152	162	155	124
15		176	162	164	175	159	129
14		179	166	170	186	164	132
13		182	175	179	197	168	147
12		189	187	190	212	186	166
11		205	210	210	248	251	189
10		239	223	228	273	321	276
9		264	243	259	334	386	368
8		306	266	298	412		444
7		369	352	380			

## ISOTHERM DEPTHS (M)

R/V WHITING WHI-STAC831-88

XBT NO.	22	23	24	25	26	27	28
YEAR	88	88	88	88	88	88	88
MONTH	7	7	7	7	7	7	7
DAY (GMT)	12	12	13	13	15	15	15
TIME (GMT)	1915	2149	0553	1456	0022	0354	0752
LAT (N)	7.85	8.28	8.48	7.80	7.97	8.50	9.03
LON (W)	51.35	51.55	52.14	52.60	54.17	54.68	55.27
SURF T (C)	29.6	29.8	27.0	28.7	26.0	26.0	28.2
29		6	8				
28		52	43				
27		84	75	10	59		
26		93	87	77	72	24	22
25		104	93	91	78	83	77
24		110	96	97	84	93	84
23		112	103	106	86	96	101
22		114	111	110	108	98	105
21		117	125	118	121	100	112
20		123	138	126	127	103	122
19		132	146	134	134	107	128
18		136	152	141	141	116	133
17		139	161	151	149	125	143
16		141	169	160	160	133	152
15		145	178	166	167	144	164
14		154	185	172	177	154	174
13		164	200	185	183	166	196
12		189	208	197	190	184	208
11		232	220	217	219	224	240
10		281	233	255	239	239	271
9		317	255	301	258	286	314
8		399	302	392	400	350	383
7		459	489	507	451	484	504

## ISOTHERM DEPTHS (m)

R/V WHITING

WHI-STAC531-88

XBT NO.	29	30	31	32	33
YEAR	68	68	68	68	68
MONTH	7	7	7	7	7
DAY (GMT)	15	15	15	16	16
TIME (GMT)	1119	1509	1850	0249	0942
LAT (N)	9.53	10.07	10.60	11.62	12.60
LON (W)	55.79	56.35	56.93	58.05	59.15
SURF T (C)	26.0	26.0	28.3	28.3	26.0
29					
28			11	9	
27			37	43	
26	34	28	61	78	32
25	86	90	80	91	97
24	97	104	87	100	106
23	111	114	93	106	112
22	121	134	101	114	122
21	131	138	108	124	138
20	146	153	113	134	150
19	158	168	119	140	159
18	169	178	128	143	168
17	175	188	142	157	188
16	182	194	156	176	201
15	191	199	162	203	220
14	196	209	171	220	239
13	204	224	180	232	254
12	213	239	209	241	273
11	253	268	229	256	305
10	328	326	265	387	370
9	362	412	331	425	420
8	431	459	475	505	505
7	488	549	608	621	608

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL		MIT-STACS32-88					
XBT NO.	1	2	3	4	5	6	7
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	12	12	12	12	12	12	12
TIME (GMT)	1621	1659	1755	1855	2002	2101	2200
LAT (N)	12.92	12.88	12.86	12.81	12.78	12.75	12.72
LON (W)	59.25	59.10	58.92	58.73	58.53	58.35	58.15
SURF T (C)	28.5	28.5	28.7	28.5	28.3	28.0	28.5
28	39	38	43	40	43	45	40
27	68	63	77	70	60	61	65
26	83	83	94	82	82	79	79
25	97	98	113	103	96	89	95
24	118	106	123	111	111	100	99
23	128	123	134	126	121	107	106
22	142	137	148	143	137	123	135
21	155	150	162	164	157	135	145
20	174	172	180	183	169	152	158
19	202	192	205	198	186	175	175
18	223	209	217	207	197	189	188
17	239	237	235	231	214	198	206
16	259	257	265	259	232	218	220
15	271	281	289	275	257	229	235
14	283	298	323	298	277	249	251
13	310	331	346	316	295	266	273
12	345	356	375	352	316	297	298
11	374	389	413	377	350	327	324
10	397	412	437	413	387	368	378
9				439	438	420	
8							
7							
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL		MIT-STACS32-88					
XBT NO.	8	9	10	11	12	13	14
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	13	13	13	13	13	13	14
TIME (GMT)	0655	0803	0900	1000	1056	1940	0625
LAT (N)	12.39	12.35	12.31	12.27	12.24	11.85	11.17
LON (W)	56.35	56.12	55.92	55.73	55.53	54.82	53.55
SURF T (C)	27.9	28.2	28.5	28.4	28.7	28.9	28.5
28	33	32	35	36	39	37	44
27	43	44	57	68	68	64	55
26	70	69	78	79	84	81	63
25	84	94	96	96	105	94	74
24	98	101	105	100	113	99	89
23	108	112	111	103	118	106	94
22	119	123	117	106	122	111	101
21	124	134	130	114	126	115	113
20	128	145	139	123	141	132	122
19	140	152	152	130	153	137	130
18	150	161	163	144	163	147	135
17	159	170	174	173	167	158	142
16	177	176	192	189	179	182	149
15	203	187	205	202	189	203	158
14	213	208	212	218	207	226	167
13	239	229	249	243	256	249	183
12	263	268	276	257	292	279	204
11	293	326	300	321	343	327	230
10	332	354	329	389	387	365	302
9	417	409			424	378	
8							
7							
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL		MIT-STACS32-88					
XBT NO.	15	16	17	18	19	20	21
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	13	13	13	13	13	13	14
TIME (GMT)	0655	0803	0900	1000	1056	1940	0625
LAT (N)	12.39	12.35	12.31	12.27	12.24	11.85	11.17
LON (W)	56.35	56.12	55.92	55.73	55.53	54.82	53.55
SURF T (C)	27.9	28.2	28.5	28.4	28.7	28.9	28.5
28	33	32	35	36	39	37	44
27	43	44	57	68	68	64	55
26	70	69	78	79	84	81	63
25	84	94	96	96	105	94	74
24	98	101	105	100	113	99	89
23	108	112	111	103	118	106	94
22	119	123	117	106	122	111	101
21	124	134	130	114	126	115	113
20	128	145	139	123	141	132	122
19	140	152	152	130	153	137	130
18	150	161	163	144	163	147	135
17	159	170	174	173	167	158	142
16	177	176	192	189	179	182	149
15	203	187	205	202	189	203	158
14	213	208	212	218	207	226	167
13	239	229	249	243	256	249	183
12	263	268	276	257	292	279	204
11	293	326	300	321	343	327	230
10	332	354	329	389	387	365	302
9	417	409			424	378	
8							
7							
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL		MIT-STACS32-88					
XBT NO.	22	23	24	25	26	27	28
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	14	14	15	15	16	16	16
TIME (GMT)	1834	0455	1328	2303	0727	1329	2007
LAT (N)	10.50	9.67	8.99	8.30	7.64	6.95	6.18
LON (W)	52.13	50.62	49.42	48.17	47.69	48.09	48.65
SURF T (C)	29.4	28.5	28.8	29.2	29.1	28.9	29.1
28	40	48	48	44	47	36	67
27	53	65	64	54	60	59	89
26	64	80	81	66	67	78	103
25	74	93	99	71	72	88	138
24	82	99	104	77	77	95	146
23	88	106	107	84	85	102	149
22	92	115	110	92	90	111	156
21	100	123	128	97	100	119	160
20	104	140	135	102	106	124	161
19	112	144	141	109	116	134	162
18	130	149	148	117	125	140	163
17	140	157	156	123	130	150	165
16	150	172	166	128	136	157	168
15	160	183	178	133	144	163	170
14	173	195	188	143	153	169	173
13	187	206	197	150	171	178	176
12	204	223	217	163	189	191	188
11	250	249	239	190	199	218	218
10	325	320	297	230	220	257	262
9	415	372	391	282	250	338	298
8				422	299	399	371
7					350		
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL

MIT-STACS32-88

XBT NO.	29	30	31	32	33	34	35
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	17	17	17	17	17	17	17
TIME (GMT)	0258	0851	1241	1456	1601	1700	1800
LAT (N)	5.26	4.66	4.30	4.35	4.58	4.81	5.08
LON (W)	49.02	49.39	49.66	49.76	49.82	49.92	50.10
SURF T (C)	28.7	28.4	27.1	27.2	28.8	28.9	28.9
28	33	20		14	19	15	
27	79	89	22	16	79	74	75
26	155	152	152	162	158	145	155
25	161	182	158	166	165	169	164
24	166	186	159	167	168	171	167
23	174	187	160	168	170	171	169
22	176	188	161	170	172	172	171
21	178	189	162	171	174	173	173
20	179	190	162	172	175	174	174
19	180	191	163	173	176	176	176
18	182	192	164	173	177	178	177
17	183	193	165	174	177	181	178
16	184	193	166	175	178	182	180
15	185	194	167	176	179	183	182
14	187	195	168	176	179	184	185
13	194	196	170	177	180	185	187
12	202	198	172	179	181	187	190
11	237	206	182	184	183	203	217
10	287	220	217	205	236	239	242
9	328	301	264	268	310	301	315
8	398	375	355	322	366	359	351
7	412			435	405	433	
6							6

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL

MIT-STACS32-88

XBT NO.	36	37	38	39	40	41	42
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	17	17	17	17	17	17	18
TIME (GMT)	1855	1959	2058	2203	2301	2357	0056
LAT (N)	5.30	5.56	5.81	6.04	6.28	6.51	6.75
LON (W)	50.18	50.24	50.31	50.48	50.60	50.68	50.71
SURF T (C)	28.8	28.8	28.7	28.6	28.7	28.9	28.8
28	17	13	15	14	17	17	18
27	87	111	106	84	115	127	117
26	132	140	151	146	148	156	144
25	172	171	186	176	166	173	164
24	173	173	192	191	177	181	168
23	174	174	193	196	184	184	175
22	175	175	194	197	188	188	185
21	176	177	194	198	191	190	190
20	177	178	195	199	193	192	199
19	178	179	196	200	194	209	207
18	179	180	196	200	198	215	210
17	179	181	197	201	215	220	218
16	180	183	197	202	220	227	223
15	182	186	198	204	229	236	227
14	184	188	199	218	235	245	236
13	188	191	201	224	238	256	248
12	207	201	223	231	246	264	255
11	215	220	237	255	263	274	271
10	229	244	263	275	294	297	302
9	297	311	315	298	332	322	344
8	373	389	368	345	370	361	383
7	415	427	428	419			
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL

MIT-STACS32-88

XBT NO.	43	44	45	46	47	48	49
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	18	18	18	18	18	18	18
TIME (GMT)	0202	0258	0359	0457	0600	0655	0759
LAT (N)	7.00	7.22	7.47	7.70	7.93	8.14	8.37
LON (W)	50.88	50.96	51.06	51.13	51.22	51.32	51.43
SURF T (C)	28.7	28.8	28.8	28.4	28.5	28.5	28.1
28	16	14	14	12	12	14	10
27	133	117	111	89	78	76	32
26	155	145	141	137	124	117	102
25	165	158	149	146	137	136	130
24	170	161	166	160	150	146	137
23	174	174	173	168	160	149	141
22	181	179	179	177	164	154	146
21	189	187	183	185	170	159	149
20	197	193	187	188	172	162	150
19	201	198	205	199	174	165	151
18	204	215	208	204	176	168	152
17	206	219	215	210	179	169	154
16	224	223	225	220	183	172	156
15	229	233	236	225	187	181	164
14	237	246	251	237	194	190	170
13	249	264	268	244	215	205	186
12	253	286	274	302	241	242	215
11	269	305	300	330	295	298	281
10	311	334	348	383	339	353	334
9	342	375	418	435			
8	399	417					
7							
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL

MIT-STACS32-88

XBT NO.	50	51	52	53	54	55	56
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	18	18	18	18	18	19	20
TIME (GMT)	0902	1000	1058	1702	1914	1900	0030
LAT (N)	8.57	8.78	8.95	8.90	8.61	8.68	8.20
LON (W)	51.58	51.64	51.78	51.83	52.06	52.05	52.35
SURF T (C)	28.1	28.1	28.5	28.5	29.5	28.6	
28	15	29	23	12	17	10	10
27	69	66	46	45	60	53	60
26	109	93	81	71	80	75	91
25	129	106	96	87	92	91	109
24	131	109	105	90	95	96	118
23	133	112	110	93	99	101	122
22	138	117	114	97	105	107	125
21	140	125	118	103	113	113	128
20	143	130	121	109	118	117	135
19	146	133	129	112	122	122	138
18	149	135	133	116	126	124	142
17	151	139	136	118	128	126	145
16	154	143	138	120	130	128	146
15	159	147	141	127	137	137	149
14	168	156	153	136	147	145	151
13	191	188	181	163	169	180	164
12	217	218	220	184	183	196	184
11	285	277	255	223	222	242	244
10	336	344	324	293	280	300	288
9	448	434	400	395	413	409	395
8							
7							
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL MIT-STACS32-88

XBT NO.	57	58	59	60	61	62	63
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	20	20	21	21	21	21	21
TIME (GMT)	0523	1230	0758	0909	1000	1055	2001
LAT (N)	8.01	7.78	7.58	7.43	7.35	7.24	7.02
LONG (W)	52.52	52.65	52.83	52.90	53.01	53.03	53.09
SURF T (C)	28.2	27.8	28.1	27.8	27.6	27.7	28.3
28	7	7	7				4
27	55	45	67	64	20	26	20
26	94	93	72	80	72	70	65
25	101	99	77	83	80	78	69
24	111	106	81	92	89	93	73
23	121	113	89	98	95	96	75
22	128	118	105	104	100	109	81
21	131	121	111	109	112	122	90
20	137	125	115	115	127	129	106
19	140	129	120	121	138	139	140
18	153	133	128	126	149	149	152
17	156	147	131	131	159	159	159
16	158	151	134	138	174	165	171
15	161	157	173	176	182	173	184
14	166	165	194	196	195	188	
13	171	175	204	206	208	205	
12	186	218	219	211	223	218	
11	238	257	249	220	251	245	
10	289	299	293	237	273	287	
9	379	388		256	355	362	
8	426	437			420	417	
7							
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL MIT-STACS32-88

XBT NO.	64	65	66	67	68	69	70
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	21	22	21	22	22	22	22
TIME (GMT)	2306	0004	0103	0150	0255	0357	0452
LAT (N)	7.09	7.23	7.35	7.46	7.60	7.72	7.81
LONG (W)	53.10	53.22	53.32	53.41	53.56	53.69	53.80
SURF T (C)	27.9	27.8	27.5	27.9	28.1	28.1	28.3
28	4				12	19	17
27	16	21	42	48	50	52	68
26	59	57	61	64	62	59	78
25	66	71	72	70	70		
24	80	73	76	79	75	78	92
23	89	77	92	89	87	85	97
22	108	91	97	101	93	94	104
21	126	96	117	110	108	107	110
20	138	111	125	128	121	125	115
19	149	123	142	135	130	131	123
18	168	140	147	154	135	139	133
17	175	169	164	162	143	151	141
16	181	184	193	168	154	163	152
15	192	197	202	190	175	181	164
14	214	213	215	200	185	191	176
13	228	224	222	211	195	211	189
12	238	258	234	225	207	225	201
11		282	254	263	240	247	217
10			300	308	285	260	242
9					331	348	283
8						396	377
7							
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL MIT-STACS32-88

XBT NO.	71	72	73	74	75	76	77
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	22	22	22	22	22	22	22
TIME (GMT)	0554	0657	0801	0903	1000	1100	1200
LAT (N)	7.93	8.05	8.18	8.30	8.38	8.49	8.64
LONG (W)	53.93	54.06	54.19	54.31	54.44	54.54	54.65
SURF T (C)	28.4	28.4	29.1	29.0	29.1	29.3	29.2
28	16	34	41	28	37	31	29
27	61	66	63	53	52	50	49
26	73	76	74	69	61	63	60
25	83	88	78	74	69	68	67
24	90	92	84	78	74	72	77
23	96	100	89	86	86	82	82
22	105	109	92	97	91	87	87
21	111	116	100	110	95	95	90
20	120	121	112	119	107	99	94
19	139	127	128	125	113	110	99
18	147	135	144	141	121	117	103
17	152	147	153	146	132	125	105
16	159	155	164	159	139	136	108
15	168	174	173	168	148	147	114
14	177	187	183	180	154	154	118
13	188	203	198	202	164	163	127
12	210	216	219	222	177	214	142
11	237	248	250	293	210	314	195
10	278	315	314	337	304	263	
9	307	363	365	413	377	369	
8	398		410		475	492	
7			496				
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL MIT-STACS32-88

XBT NO.	78	79	80	81	82	83	84
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	22	22	22	22	22	22	22
TIME (GMT)	1258	1403	1501	1555	1651	1753	1852
LAT (N)	8.73	8.86	8.98	9.08	9.18	9.29	9.38
LONG (W)	54.74	54.85	54.96	55.06	55.17	55.28	55.41
SURF T (C)	29.2	29.2	29.5	29.3	29.3	29.4	29.7
28	33	31	31	30	32	33	35
27	48	48	56	48	51	53	57
26	61	62	66	67	69	71	74
25	69	74	73	75	79	79	78
24	75	78	82	87	91	86	87
23	80	82	87	90	97	96	96
22	82	85	90	93	102	102	106
21	84	91	94	97	105	111	117
20	94	99	102	104	108	122	124
19	102	111	110	119	119	136	139
18	107	114	115	136	140	148	148
17	109	117	119	147	160	158	157
16	112	120	134	153	165	176	167
15	116	122	138	160	181	190	180
14	119	126	141	176	195	205	191
13	124	138	158	185	216	230	209
12	141	159	185	199	253	245	237
11	200	221	224	233	283	292	267
10	279	298	317	366	334	341	309
9	384	386	378	403	377	391	370
8		483		444	427	436	417
7				476		473	
6				575		554	

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL		MIT-STACS32-88					
XBT NO.	85	86	87	88	89	90	91
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	22	22	22	22	23	23	23
TIME (GMT)	1958	2058	2158	2259	0001	0100	0202
LAT (N)	9.51	9.63	9.74	9.85	9.95	10.06	10.16
LON (W)	55.54	55.65	55.74	55.85	55.95	56.06	56.17
SURF T (C)	29.3	29.4	29.2	29.1	29.3	29.2	29.3
28	33	39	44	36	41	43	42
27	52	59	63	51	55	55	57
26	73	77	82	66	68	71	68
25	78	86	90	77	77	79	78
24	84	92	94	86	84	87	85
23	93	103	97	91	94	94	91
22	104	108	111	99	105	111	105
21	117	123	114	118	116	119	116
20	126	129	130	128	121	126	128
19	133	137	138	137	134	133	136
18	144	147	143	149	145	142	144
17	149	159	151	159	152	155	156
16	150	175	161	167	162	163	162
15	175	194	180	177	173	172	170
14	192	209	194	191	186	185	182
13	208	232	210	204	194	208	198
12	219	242	226	225	210	218	219
11	238	257	250	245	249	276	276
10	259	286	261	290	309	313	306
9	324	317	281	339	367	368	351
8	367	349	336	396	429	433	414
7	439	403	408		520	526	504
6	571		494		636	671	628

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL		MIT-STACS32-88					
XBT NO.	92	93	94	95	96	97	98
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	23	23	23	23	23	23	23
TIME (GMT)	0259	0100	0202	0259	0848	1346	1740
LAT (N)	8.67	10.06	10.16	10.26	9.79	9.24	8.84
LON (W)	57.81	56.06	56.17	56.27	56.64	56.99	57.26
SURF T (C)	29.5	29.2	29.3	29.2	29.2	29.4	29.7
28	67	43	42	44	58	67	70
27	81	55	57	58	79	87	96
26	89	71	68	71	93	94	107
25	95	79	78	81	103	108	119
24	104	87	85	86	113	129	130
23	112	94	91	91	121	138	162
22	133	111	105	106	125	147	167
21	157	119	116	114	145	152	173
20	171	126	128	124	155	159	184
19	179	133	136	137	167	168	193
18	187	142	144	146	175	175	204
17	192	155	156	153	183	194	212
16	199	163	162	163	194	202	225
15	212	172	170	173	211	211	238
14	228	185	182	179	219	222	249
13	248	208	198	195	255	233	264
12	264	218	219	209	261	248	283
11	299	276	276	267	294	304	326
10	335	313	306	305	330	343	367
9	376	368	351	375	383	396	427
8		433					
7		526					
6		662					

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL		MIT-STACS32-88					
XBT NO.	99	100	101	102	103	104	105
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	24	23	23	23	23	23	23
TIME (GMT)	0255	0100	0202	0259	0848	1346	1740
LAT (N)	8.67	10.06	10.16	10.26	9.79	9.24	8.84
LON (W)	57.81	56.06	56.17	56.27	56.64	56.99	57.26
SURF T (C)	29.5	29.2	29.3	29.2	29.2	29.4	29.7
28	67	43	42	44	58	67	70
27	81	55	57	58	79	87	96
26	89	71	68	71	93	94	107
25	95	79	78	81	103	108	119
24	104	87	85	86	113	129	130
23	112	94	91	91	121	138	162
22	133	111	105	106	125	147	167
21	157	119	116	114	145	152	173
20	171	126	128	124	155	159	184
19	179	133	136	137	167	168	193
18	187	142	144	146	175	175	204
17	192	155	156	153	183	194	212
16	199	163	162	163	194	202	225
15	212	172	170	173	211	211	238
14	228	185	182	179	219	222	249
13	248	208	198	195	255	233	264
12	264	218	219	209	261	248	283
11	299	276	276	267	294	304	326
10	335	313	306	305	330	343	367
9	376	368	351	375	383	396	427
8		433					
7		526					
6		662					

R/V MT MITCHELL		MIT-STACS32-88					
XBT NO.	106	107	108	109	110	111	112
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	23	24	24	24	24	24	24
TIME (GMT)	2142	0105	0203	0255	1353	1459	1557
LAT (N)	8.40	8.36	8.49	8.67	10.49	10.66	10.81
LON (W)	57.53	57.68	57.75	57.81	58.57	58.62	58.70
SURF T (C)	29.5	29.3	29.0	29.5	29.4	29.5	29.6
28	57	64	51	67	62	63	56
27	73	81	75	81	70	76	73
26	82	88	81	89	79	80	81
25	96	99	92	95	87	83	87
24	100	103	99	104	91	89	94
23	110	111	108	112	95	109	98
22	126	127	122	133	102	114	101
21	147	147	137	157	120	129	115
20	156	153	157	171	134	136	131
19	163	173	163	179	142	145	141
18	169	183	169	187	150	157	154
17	179	207	181	192	159	166	167
16	190	216	193	199	175	180	175
15	212	223	201	212	194	195	191
14	227	238	215	228	210	202	210
13	242	255	242	248	238	214	228
12	258	276	253	264	255	246	247
11	282	324	269	299	289	292	284
10	313	363	311	335	331	331	313
9	359		357	376	392	386	343
8		414			477		412
7		504			557		504
6		629			667		667

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL

MIT-STACS32-88

XBT NO.	113	114	115	116	117	118	119
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	24	24	24	24	24	24	24
TIME (GMT)	1653	1757	1859	1959	2102	2201	2301
LAT (N)	10.97	11.12	11.25	11.41	11.58	11.73	11.88
LONG (W)	58.76	58.86	58.95	59.02	59.10	59.16	59.23
SURF T (C)	29.4	29.9	29.6	30.2	29.6	29.4	29.2
28	50	38	33	43	35	39	39
27	63	67	49	69	64	73	65
26	82	79	64	80	78	90	87
25	88	86	75	89	84	111	98
24	97	105	99	110	105	119	123
23	108	114	107	119	115	132	139
22	116	119	119	134	137	138	145
21	121	130	134	139	151	156	153
20	129	139	144	150	163	168	159
19	137	147	151	161	167	183	168
18	148	166	167	169	183	193	186
17	166	177	179	189	207	207	209
16	178	183	198	212	221	221	229
15	195	190	215	228	240	232	254
14	213	209	236	246	252	258	271
13	226	235	259	262	278	275	291
12	243	258	296	273	297	296	315
11	294	272	321	305	345	320	343
10	326	303	377	353	412	374	391
9	356	353	416	396	471	440	
8	411	404		443		549	
7		480		539		601	
6		672		645		648	

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL

MIT-STACS32-88

XBT NO.	120	121	122	123	124	125	126
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	25	25	26	26	26	27	27
TIME (GMT)	0001	0103	0201	0301	0354	0450	0550
LAT (N)	12.01	12.15	12.26	12.41	12.52	12.59	12.68
LONG (W)	59.28	59.33	59.37	59.43	59.47	59.50	59.53
SURF T (C)	29.3	29.2	28.9	28.9	28.8	29.1	29.1
28	36	39	32	46	36	43	51
27	66	60	53	62	54	60	62
26	79	75	74	80	75	76	76
25	94	93	100	93	93	97	95
24	113	108	115	112	106	109	104
23	122	118	124	121	117	125	115
22	136	131	137	131	131	143	125
21	144	143	146	145	138	156	144
20	152	160	153	152	154	174	156
19	166	174	160	163	171	189	173
18	183	183	173	190	185	196	185
17	200	197	197	199	203	214	199
16	219	208	212	217	218	231	214
15	234	226	227	231	229	248	240
14	247	245	250	244	244	270	262
13	265	272	265	259	259	283	278
12	282	294	283	275	282	290	294
11	332	315	313	315	308	342	318
10	389	386	365	360	338	370	373
9	443		413	417	390	420	417
8	525		495		462		488
7	574		594		570		581
6	668		709		689		683

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL

MIT-STACS32-88

XBT NO.	127	128	129	130	131	132	133
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	9	9
DAY (GMT)	25	25	26	26	26	27	27
TIME (GMT)	0656	0803	0004	0434	1156	0001	1200
LAT (N)	12.77	12.86	13.31	13.73	15.03	17.05	18.75
LONG (W)	59.57	59.61	60.36	61.18	62.44	64.42	66.21
SURF T (C)	28.8	28.5	29.6	29.3	29.0	29.3	28.5
28	49	55	46	47	51	58	49
27	68	69	57	64	63	70	57
26	79	82	69	88	81	77	73
25	88	92	83	113	95	92	107
24	100	97	87	125	107	108	122
23	109	111	111	134	113	130	147
22	120	127	146	150	144	144	162
21	131	140	150	156	159	158	175
20	147	157	174	173	172	177	197
19	158	174	190	186	198	199	228
18	184	182	205	197	214	227	269
17	197	206	220	208	231	241	303
16	208	229	244	224	250	266	342
15	227	261	273	249	276	290	400
14	238	281	302	284	310	325	446
13	247	292	330	308	350	358	
12	261	309	357	335	375	384	
11	297	319	387	365	426	438	
10	335	337	421	429			
9	415	410					
8							
7							
6							

## ISOTHERM DEPTHS (M)

R/V MT MITCHELL

MIT-STACS32-88

XBT NO.	134	135	136	137	138	139	140
YEAR	88	88	88	88	88	88	88
MONTH	9	9	9	9	9	10	10
DAY (GMT)	28	28	29	29	29	4	4
TIME (GMT)	0001	1200	0000	0008	1201	0000	1200
LAT (N)	19.63	20.31	23.54	21.04	21.95	27.02	27.47
LONG (W)	68.98	71.79	79.26	74.57	77.19	79.68	78.92
SURF T (C)	28.8	28.1	29.0	29.1	28.8	28.7	28.6
28	26	7	45	19	46	56	79
27	38	33	73	30	58	75	86
26	58	48	96	46	66	83	95
25	74	67	120	65	101	98	104
24	95	93	141	104	115	109	113
23	141	113	156	141	147	121	128
22	162	129	178	162	172	133	156
21	177	160	202	179	199	143	180
20	197	200	234	204	224	166	205
19	226	222	267	243	254	194	248
18	275	274	310	319	307	210	
17	333	338	347	364	361	228	
16	391	390	389	399	409	256	
15	436	427	437			283	
14						311	
13						348	
12						366	
11						391	

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## ISOTHERM DEPTHS (M)

R/V MT MITCHELL

MIT-STACS32-88

XBT NO.	141	142	143	144	145	146	147
YEAR	88	88	88	88	88	88	88
MONTH	10	10	10	10	10	10	10
DAY (GMT)	5	5	6	6	7	8	9
TIME (GMT)	0007	0929	0001	0800	0002	0000	0009
LAT (N)	26.55	26.52	26.50	26.49	26.46	26.53	25.78
LONG (W)	76.84	76.76	76.45	76.53	76.15	76.74	77.23
SURF T (C)	28.7	28.7	28.5	28.4	28.5	28.4	28.6
28	61	58	49	49	46	43	59
27	65	62	52	53	49	49	68
26	71	67	59	61	60	56	75
25	75	82	68	72	71	66	94
24	104	101	83	90	82	80	101
23	131	121	105	106	98	97	130
22	154	139	138	128	123	127	148
21	180	163	162	156	149	153	170
20	219	195	190	207	177	190	193
19	274	275	253	255	236	249	262
18	387	386	402	374	375	372	346
17							408
16							
15							
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